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AND

MECHANICS' REGISTER.

DEVOTED TO

MECHANICAL AND PHYSICAL SCIENCE,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

EDITED

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JULY, 1836.

Practical and Theoretical Mechanics.

Experiments on the resistance of sand to motion through tubes, with especial reference to its use in the blasting of rocks, made at Fort Adams, Newport harbour, under the direction of Col. Totten. By Lieut. T. S. Brown, of the Corps of Engineers.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen: The great quantity of rock excavation required at Fort Adams, Newport, R. I. created, at an early period of the operations, an earnest desire, on the part of the officers of engineers charged with the construction of that work, to devise some method of loading and securing the drill holes which would be less dangerous to the workmen than the one which had been usually employed. For this purpose resort was had to the use of clean dry sand in the manner which will be hereafter described, it being understood that that expedient had been successfully tried at other places. It was found, however, that great prejudices existed among the workmen on this subject, and that from their belief of the inefficiency of the new method, they required to be constantly watched, to prevent them

* We are compelled to divide this interesting paper. The first part, consisting mainly of a translation of the essay of M. H. Burnand, is now given, and the experiments which form the more important part of the paper, will follow in the next number.

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from jeoparding their own safety, by returning to the old practice of filling the holes with fragments of stones and bricks, driven in with violence above the powder. It appeared to be important that the doubts of the workmen should be put at rest, and that several practical questions connected with the use of sand, in blasting, should be solved, and it was the intention of Colonel Totten, the superintending engineer, that experiments should be made for these purposes. This intention was confirmed by the appearance, in the "Journal of the Royal Institution," and in the "American Journal of Science," of brief notices, of a paper describing some interesting experiments on the flow and pressure of sand, which had been made in Europe. I was accordingly directed to institute a series of trials, having for their object, to determine the degree and nature of the resistance offered by sand when it is attempted to force it through a tube by direct pressure, and it was intended, at the same time, to investigate, more thoroughly, some of the properties of this substance which were developed in the European experiments just mentioned.

The experiments made in consequence of these instructions were prosecuted at distant intervals of leisure during the years 1829 and 1830, but they were interrupted before all had been accomplished, which had been originally designed; nevertheless, the results obtained were interesting, and it is thought that a brief account of them may be acceptable to the readers of your Journal.

Having, subsequently to making the experiments, procured, through the kindness of my friend, Professor A. D. Bache, a copy, in French, of the original paper above referred to, which has been several times re-published in Europe, I have translated it at length, from the "Annales de Chimie et de Physique," vol. XL, page 159, and prefix the translation to the summary of my own investigations.

TRANSLATION.

Letter of M. Huber Burnand, to Professor Prevost, on the flow and pressure of sand.

[M. Huber Burnand, two years since, presented to the Society of Physics and Natural History of Geneva, an anemometer, in which the force and duration of the wind, were measured by the quantity of sand which escaped from a variable opening, proportioned in size to the force which it was proposed to measure. On this subject, M. Prevost proposed the following question. Does not the sand in its flow, correspond in a certain degree with a liquid, and is not its discharge in consequence, more rapid, as the head in the vessel which contains it is greater? He indicated at the same time, the further researches which might be made as to the mode of action of the sand, in regard to the pressure which it exerts. Such is the origin and motive of the experiments submitted by M. Burnand to M. Prevost in this letter, which has been kindly communicated to us for publication.]

By preliminary trials, I ascertained that the two following precautions are necessary to obtain a tolerably regular flow of sand. First, it is indispensable that the sand should be sifted with the greatest care, but that it should not be as fine as flour. The sand used by founders would be too fine for this purpose; its fall would be irregular and would be frequently interrupted without any assignable cause. If, instead of this, we take the sand used in making tiles, and carefully sift it through a cotton gauze, the holes of which are produced by a web, which presents thirty-eight threads

by forty-five in the space of one square inch, we shall find it to flow with the greatest facility. The second condition necessary to the uninterrupted flow of the sand, is that the opening should have a diameter of at least $\frac{1}{12}$ of an inch.

These first questions settled, I could proceed to the researches which I had in view. For this purpose, I had made two wooden boxes, one thirty-one inches high, with a bottom twelve inches square, and another forty-seven inches high, with a bottom only four inches square. They were open at the top, and provided at the bottom with four small boards, sliding in grooves disposed in the form of a cross, so as to permit the aperture to be widened or lengthened at pleasure. The slides were made thin, so that the flow should not be affected by the thickness of the wood, a circumstance the inconveniences of which, I had already discovered. These two boxes were raised on four legs, for the convenience of experimenting, and I procured an excellent stop watch to ensure accuracy in the results. The volumes were measured in a graduated glass tube, and I had also obtained a very sensible balance, with very exact metrical decimal weights. I must add that all my trials were repeated several times, and that I had acquired by long practice, such skill in these experiments, that an error of a quarter of a second in time, would have been detected in the results.

In the most delicate experiments, I introduced metallic slides graduated to $\frac{4}{100}$ths. of an inch, instead of the wooden ones: they were however, still by no means as exact as was desirable.

I shall divide my researches into two parts; those which have for their special object the flowing of sand, and those which refer more particularly to its pressure, as serving to explain the phenomena ascertained in relation to the first subject.

I. *The flow of Sand.*

1. The quantity of sand which flowed in a given time from a given opening, was absolutely the same, both by volume and weight, whatever the height of the sand in the box at the commencement of the experiment There were nevertheless, occasional variations, more or less, of two or three grammes.* They were caused, most frequently, by the difficulty of introducing and withdrawing, at the proper moment, the vessel which was used to receive the sand. The errors compensated for each other, and disappeared when quantities as great as from four to five hundred grammes were employed. Three minutes were ordinarily employed in an experiment. The quantities obtained during the consecutive ninety seconds, were weighed, and when the weights were equal we called them accurate.

The weights were placed together, and compared afterwards with others obtained in the same manner, with columns of sand of ten times the height. The results were always perfectly alike.

2. The quantity of sand flowing through a hole from $\frac{1}{8}$th. to $\frac{1}{12}$th. of an inch wide, was always in direct proportion to the length of the opening, a fact which is susceptible of very useful applications in several Philosophical instruments. But the least variation in the breadth of the opening, caused in the quantity of sand flowing out, an increase, which exceeded the simple ratio of the surfaces of the orifice, as far, at least, as I could judge with the imperfect means which were at my disposal.

3. The sand escaping through openings in the side of the box, flow-

*A *Gramme* is about $15\frac{1}{2}$ grains. Tr.

ed with the same velocity whatever the height of the column was. But if the holes were placed horizontally, and had not a vertical dimension about equal to the thickness of the board, not a single grain of sand fell from them, whatever its height in the box.

4. Sand poured into one branch of a tube bent twice at right angles, does not rise in the opposite branch as a liquid does; it only extends a very small distance from the elbow into the horizontal part.

5. Whatever may be the pressure to which sand contained in a box is subjected, it does not influence in any manner, the quantity which flows out through a given opening situated at the bottom of the box or in the sides. The experiment was made successively with masses of iron weighing from twenty-six to fifty-five pounds.

6. A graduated rod inserted perpendicularly in the top of the column of sand, and precisely in the direction of an opening below, descends in and with the sand without inclining in any direction, and with a motion nearly as uniform as that of a clock. A rod fifteen inches long, was made at pleasure to descend $\frac{4}{10}$ths. of an inch per minute or per second. An overshot wheel placed in the interior of the box, and provided with an index outside, also moved with astonishing regularity, but very slowly. If the rod, instead of being placed in the axis of motion, was placed nearer the sides of the box, it inclined with great uniformity, but at the same time descended and advanced towards the centre with a very slow motion. The velocity of this rod depends then, principally on its position in the sand, and next on the size of the orifice. The velocity is probably also proportional to the ratio which exists between the surface of the orifice and the horizontal section of the box, since it depends upon the quantity which flows out during each instant, compared with the whole quantity.

With more care and several modifications of the apparatus, it would probably be possible to produce more regularity than I have attained, in the progress of movable bodies, carried along by the friction of the sand.

I will remark in passing, that there probably does not exist any other natural force on the earth, which produces of itself a perfectly uniform movement, and which would not be altered by gravitation, by friction, or by the resistance of the air. We see that the height of the column has no influence on the velocity of motion of the sand, neither increasing nor diminishing it. As to friction, far from being an obstacle, it is itself the direct cause of the regularity and uniformity of the movement, as will be shown in the sequel of my experiments; and the resistance of the air in the interior of a column of sand in motion, must be very small indeed, since none of the grains fall freely. The hour glass, a time piece, which preceded all others, was thus founded on a much more philosophical basis than has been supposed, and I venture to flatter myself that my researches may be of some use to it, in its application to the arts and to science.

7. After having studied sand in motion, I examined its mode of action when distributed in heaps upon a plane.

For this purpose I began by placing isolated grains of sand on a movable plane, susceptible of being inclined at will; they hardly rolled until the plane was inclined at least, under an angle of thirty degrees, and some remained at an inclination of forty degrees, but beyond this none remained at rest. Sand never assumes a level of itself; the angle, or the angles under which it usually presents itself, after a part of its mass has crumbled, are

almost always between thirty and thirty-three degrees; it rarely maintains itself at thirty-five degrees.

In a well sifted heap, the inferior layers, themselves inclined at thirty degrees with the horizon, serve naturally as supports to the superior ones; but the greater part of the weight of these latter, is supported by the portion of the horizontal plane against which they terminate or abut. If we take away this portion of the horizontal plane or bottom, these outer layers immediately roll off, leaving those on which they rested, undisturbed and inclined under an angle of from thirty to thirty-three degrees. This explains why sand does not flow out of a horizontal opening, if the thickness of the body through which the opening is pierced, is equal to or greater than the height, or vertical dimension of the orifice. In this case the superior layers find points of support on the sides of the containing vessel, and an absolute obstacle in the inferior layers.

Is this property connected with the form of the grains of which the sand is composed? If they had more regularity we might conjecture so, but upon looking at them through a microscope, we see such a variety of figures and dimensions that it is impossible to admit this idea. The greater part of the grains are crystalline laminæ, white, flattened and variously terminated; other particles are grey, yellow, brown, &c. with such different forms that they cannot be arranged into distinct classes.

In order to decide whether the form was of any importance in the arrangement of the parts, I tried other substances besides sand, and found that peas or small shot, although with a little more difficulty in forming them into slopes, took nearly the same angle, and followed in all respects the same laws.

II. *Pressure of Sand and other Substances composed of Grains.*

1. An egg having been placed at the bottom of a box and covered with several inches of sand, the sand was loaded with a mass of iron weighing fifty-five pounds. The result was precisely what I had anticipated; the egg remained unbroken under the great weight which was placed above it.

I repeated this experiment, putting the sand in motion by means of an orifice at the bottom of the box. The result was the same, whether the egg was placed at the bottom or in the middle of the mass of sand.

These trials proved that the pressure excited by the mass of iron was deflected laterally by the interposition of the sand. They proved also, that a body placed in a mass of sand, is protected by it as it would be by a liquid, although the sand has a different kind of action from the liquid, on the sides of the vessel containing it.

These conclusions being somewhat paradoxical, I resolved to have recourse to more decisive proof.

2. I took a tube of glass open at both ends, and inserted it vertically into a small horizontal tube of wood near one end, the other end of this horizontal tube being exactly fitted into a vertical cylindrical box $\frac{4}{10}$ths. of an inch in diameter and eight inches in height.

I filled this box with mercury, as if it had been the cistern of a barometer; the mercury naturally assumed its level in the vertical tube of glass. Its height in this tube was marked. I then adapted to the box, or cylindrical cistern, a large tin tube twenty-seven inches long, and one inch and one-third in diameter. I filled this large tube with sand, taking care to pour it in very slowly, so as not to agitate the mercury.

Here was a true barometer for measuring the weight of the sand; there

was an equal pressure of air on each side, so that apparently nothing prevented the equilibrium between the sand and the mercury. Although I had in part expected the result, I was surprised to see that the sand had added nothing to the weight of the mercury; the liquid kept its level to within $\frac{1}{12}$th. of an inch, a difference which was produced by an accidental shaking of the apparatus during the experiment; for having changed the place of the apparatus, the mercury resumed its level as before the experiment, and preserved it as long as I maintained this state of things.*

I afterwards took the sand from above the mercury; it had not penetrated into the liquid. I substituted in its place dried peas; the large tube was completely filled with them, their weight being more than three pounds. I added an iron weight of upwards of two pounds, and lastly a pressure of the hand as great as I durst apply without endangering the apparatus. The mercury kept its level in the glass tube; not rising $\frac{1}{24}$th. part of an inch. The apparatus remained several days on trial without any other result. Thus the mercury had not been acted on by the weight of the sand, nor by that of the peas.

This absence of pressure on the bottom of a vessel was still better proved by the following experiments.

3. I took the same tube of tin and suspended it from a very sensible balance; I counterbalanced it exactly, and arranged it so that it reached nearly to the floor. I placed on the floor itself, a small solid cylinder of wood, about two inches high, and a little less in diameter than the large tube, so that the tube inclosed the cylinder, and could play freely in a vertical direction. As the tube was perfectly equipoised, and suspended to the arm of the balance vertically above the small solid cylinder, it moved upwards and downwards along this latter without any sensible friction.

I next weighed out a quantity of dried peas and introduced them into the large tin tube. It lost its mobility instantly, as if it had become more heavy, notwithstanding that it had no bottom, and the peas had a solid support on the top of the cylinder of wood.

I afterwards put into the opposite dish of the balance a certain number of grammes successively, until the dish descended, when the tube separated from the cylinder, allowing the escape of the peas which it had contained.

The weight required to raise the tube from the top of the cylinder was, within a very few grammes, equal to the weight of dried peas which I had poured into the tube; the difference was not more than twenty grammes, whilst the weight of the peas was more than three and a quarter pounds. The tube, therefore, appeared to be loaded with all the weight of the peas to which it gave its support.

The experiment repeated with different quantities and with additional weights always succeeded, and often within eight or ten grammes.

But it might be still objected that the lower cylinder had in some way supported the weight of the column. I therefore made the inverse experiment.

4 and 5. In this experiment I fastened the tube by two cords to two supports laterally, and suspended the small cylinder from the dish of the balance, in such a way that being equipoised before hand, it was introduced freely half an inch into the tin tube, and by the least additional weight it fell and permitted the escape of its load.

* The experiment would have been more simply made with a tube bent like a syphon with parallel branches; but M. Burnand had none at his disposal.

I then poured about three and a quarter pounds of peas into the tube, and finding that the wooden cylinder which was perfectly free, did not fall, I added a weight of two and a quarter pounds and other weights, without even moving it. It might still be objected, however, that the small cylinder adhered to the sides of the tin tube. To answer this objection, and to render this experiment more striking, I removed the cylinder, and made use of a simple disk of wood of greater diameter than the tube, and supported against its bottom by placing in the balance just weight enough to keep the two in contact. This weight was commonly from ten to twelve grammes.

I then filled the large tube with from three to four pounds of sand, and placed additional weights upon the top of the column, nevertheless the disk, retained by the small counterpoise of ten or twelve grammes, did not move. If this same weight of a few grammes had been laid on that part of the disk which projected beyond the tube, it would without doubt have caused it to fall, for it alone retained the disk in its place. A slight touch of the finger, caused the sand to pour from the lower end of the tube, and fall into a basin placed below to receive it. The disk was therefore instrumental in retaining the sand, but did not sustain the weight of it, which was all transferred to the sides of the large tin tube. Ten grammes would have caused this disk to separate from the tube, and since it remained adhering to it, the disk was not loaded with the mass of the sand.

6. To remove all kind of doubt, I gave up the use of the balance, and placing a tub of water near the large fixed tube, floated the disk of wood on the water with the smooth side upwards; I then brought the end of the tube down upon the disk, and poured water into the tub. The disk was pressed by the weight of the water against the end of the tube. I next filled the tube with dried peas but the disk did not move. It, however, was essential in retaining the peas, which without it would have fallen through the tube; but the peas did not press upon it, since a very small force would have sufficed to make them fall from the tube and thus derange the whole apparatus.

7. Leaving every thing in the same condition, I poured water into the large tube; it was kept there with the peas, for a considerable time, until an unforseen motion produced by the compressed air, which was disengaged from the bottom of the tube, caused the machine to incline. The peas then escaped into the tub, and the water flowed out at the same time. The same trial was made with sand; a considerable quantity of water was poured on the sand, fully impregnating it, and during a very long time it was supported without flowing out.

In another trial made a little differently, the sand took such a consistence with the water that it caused much trouble to get them out of the tube, which therefore entirely supported the weight of the sand and of the water, together with the force necessary to expel them.

8. We can make these experiments by simply causing the large tube to rest on a small conical heap of sand, whilst it is still suspended from the disk of the balance. The sand does not escape when the weight put into the other disk is nearly equivalent to the weight of the tube and its contents.

The same trials succeeded with grain: I have repeated them with shot with equal success, although this has a very great weight. They may also be made with a simple roll of paper tied with two small strings; they are then much more striking as the weight acquired by the paper tube contrasts better with its original lightness.

9. I have repeated these experiments with a tin tube widened at the bottom and much larger than the great tube; the result was the same, although there can be no doubt that there is a limit beyond which the sand would receive no further support from the sides of the tube. This will be the case when the inclination of these sides to a horizontal plane is the same as the slope assumed by sand in a heap, that is to say about thirty degrees. I have also repeated several of these trials with a cylindrical tube four inches in diameter, with the same success.

10. From all that I had seen I presumed that it would be very difficult to force sand through a tube even by means of a direct pressure. I made the trial in the following manner. I filled the great tube with sand and laid it in a horizontal position, and with a cylinder of wood, several feet in length, and a little less in diameter than the tube, endeavored to force out the sand at one end by pressing it at the other, but without success. It appeared to me that it would be easier to burst the tube than to move the sand a single inch. The tube being inclined to the horizon about twenty degrees, and the effect being thus aided by the weight of the body, the sand still could not be expelled; the same result followed in inclining the tube in the contrary direction. This explains very clearly wny a blast confined with sand is as effectual as any other.

Ynerduv, 15*th January* 1829.

P. S. If in the experiment in section 2, under the head of the pressure of sand, we pour water into the tube which contains the peas, the mercury will rise in the glass tube one-fourteenth of the height of the water; a proportion which corresponds with that of the specific gravities of those liquids. The water acts as usual, but the peas exert no pressure.

2nd. There is another way of making the experiment with the tube which is within the reach of every body. Procure a tin tube an inch in diameter and as long as is desired, open at both ends. Take a sheet of fine paper and apply it against the end of the tube pressing up the edges with the hand so as to make it take its form; then moisten the edges of the paper with water and cause them to adhere to the sides of the tube. Place the end on a table and fill the tube with sand. Raise it with care, and notwithstanding the slight adherence of the paper, the sand will be sustained while the tube is freely moved about.

3rd. It would be desirable to place a vessel of sand provided with an orifice for its escape, under an air pump, in order to determine whether the velocity would be affected by its flowing in a vacuum.

[*Biblioth. Univ. XL*, 22.

(TO BE CONTINUED.)

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Manufacture of Military Projectiles, Translated from the French of F. J. Culmann, Chef d'escadron d'artillerie, &c. &c. by ALFRED MORDECAI, *Captain United States Ordnance Department.*

The principal objects of this article are to point out certain faults in the manufacture of projectiles, and to indicate the means of giving them an even surface, an accurate eye, a thin seam, exact dimensions and perfect sphericity: on these points no detail will be neglected, but we shall not dwell on the description of processes which are well known in founderies.

Of the Iron used for casting Projectiles.

The kind of cast iron of which the best hollow projectiles are made is that obtained from very fusible ore, reduced with charcoal in furnaces of small elevation, at a medium heat, or by working the furnace in such a manner that the metal may be well mixed, inclining more towards a lamellar white metal than to grey, so that the laminæ, marked with greyish spots, may still be distinguished in it. The surface of a projectile made of this metal, which is very liquid, is perfectly smooth and free from flaws and holes, which is not the case with those made of grey metal, particularly of that which does not run freely. Metal inclining to white cannot be obtained with certainty from refractory ores, nor even from fusible ores if reduced with coke, or in furnaces of a certain height: this metal is moreover unsuitable for the manufacture of other articles, even for that of solid projectiles. In general, therefore the production of it is not desirable, and when accidentally obtained, it can seldom be used, because the projectiles made from it are too small; white cast iron, or that which inclines to white, shrinks more in cooling, or else at the instant of becoming solid, it expands less than the grey metal. In order to employ it usefully, therefore, the dimensions of the mould must be adapted to the properties of this kind of iron. It may also be doubted whether this brittle iron presents a sufficient resistance to the force of the powder, to prevent the projectile from being broken in leaving the piece, and to enable it to give, in certain cases, large fragments moving with sufficient velocity. It is used however in one of the iron districts of France, and with excellent results.

For the casting of hollow projectiles it is of little consequence whether the metal be good or bad, with reference to the quality of the fine iron obtained from it. It may even be said that the metal which produces a brittle iron, and which is generally very liquid, is better suited for this purpose than that which produces tough iron, provided that its bad quality does not proceed from the presence of too much silex, which would cause cracks and rents.

Castings which are to be very dense and solid, and of a medium thickness should not be made from the crude iron of coke furnaces, when it contains a large proportion of earthy minerals: a portion of the latter is thrown out when the metal is cooled by exposure to the air, and this causes flaws in the interior resembling rents; and when this metal is cooled without exposure to the air, interior crystallizations are formed, which also produce flaws. These phenomena, arising from unequal cooling, seldom occur if the castings are either very large or very thin; in the former case the metal being very liquid, heats the mould and then cools nearly at the same time throughout the mass; in the latter, the cooling is almost instantaneous.

Metal which does not contain a large proportion of earthy minerals has no tendency to form these crystallizations; an appearance which resembles them at first sight is sometimes produced by laminæ of graphite which in the cooling of the metal, collect in the interior of the mass. Crystallizations are frequently met with in the white grained metal, (when it is not produced by an overcharge of ore,) as well as in all kinds of grey-iron which contain earthy minerals.* Unless we have the exclusive use of a furnace, the di-

*These crystalline forms, so common in bombs, rarely occur in twenty-four pound howitzes, or in flasks. Out of thirty-eight ten inch and twelve inch shells, rejected for other reasons, which I have had broken, one third presented, in the fracture, crystallizations coloured yellow, crimson, &c. In six inch howitzes, we find rents produ-

mensions of the models, or globes, should be regulated according to the quality of the metal which in the particular foundry employed is best adapted for casting in sand, or for making most of the common cast iron utensils, and this is generally a mixed metal. The grey metal may also be used if it have the property of remaining liquid, which will be the case when the mixture of ore and fluxes is somewhat refractory; but if the grey metal should become thick and throw out a large quantity of graphite, it would give the projectile a very porous, wrinkled surface, covered with dross, and of an unseemly appearance. What we have said of the kind of metal best adapted for hollow projectiles, does not apply to that which should be used for making shot; white metal, or that which inclines to white, gives very ugly shot. The best is a slightly mixed metal, inclining rather to grey than to white, or else the clear grey metal, very liquid and having a pure slag. Such metal is easily obtained in furnaces fed with coke or charcoal. It is to be observed that the ore which furnishes brittle iron, whatever may be its colour, does not give as good shot as some of the ores from which medium, or tough iron is obtained; but the latter are generally of too much value for the manufacture in question. To obtain shot of an even surface, a certain quantity of the better quality should, however, always be added to the former kind.

We are at no loss to understand that white metal which, when poured into moulds, presents a very even surface, may furnish good shells, and at the same time be unfit for the fabrications of shot; because the latter must be rolled and hammered, and this metal is not adapted to either of those operations; the same may be said of almost all the ores of very brittle iron; they are not sufficiently ductile to take a smooth surface after having been hammered.

Grey metal which is a little thick, occasions, around the superior pole of the projectile, small cavities, very narrow and deep; especially if the metal has been reduced with coke of a bad quality, or from impure ores. In that case it contains a large quantity of silex, a part of which is separated from the metal by oxidation and cooling; if the ore is, besides, very fusible, the metal throws out graphite in cooling. This graphite and the silex thrown out are collected about the superior pole, where, mixed again with a certain quantity of metal, they form a soft spongy matter which gives a very bad appearance to the shot, and should cause its rejection—when metal

ced by the expulsion of the earthy minerals; but these substances are not entirely crystallized, because the metal of this projectile is thin and cools quickly. In the twenty-four pound howitzes these rents are for the same reason' very rarely found, and never in grenades. The pellicles which so often appear on the surface of projectiles, are produced only by the crystallization of the earthy minerals. These troublesome accidents may be prevented by keeping the metal for some minutes in the ladles; when poured into the moulds it then becomes well mixed, and the tendency of the foreign substances to separate from the mass is counteracted; as the metal cools more quickly this separation becomes less easy, and the flaws are neither so great nor so numerous. This precaution should not be neglected in the fabrication of projectiles; if the metal be used too hot, depressions and cavities occur in cooling. These depressions, which are found about the eye, on the interior surface of six inch and eight inch howitzes, and ten inch and twelve inch shells, are caused by rents which often extend from the centre of the thickness of the metal to its interior surface. In some foundries most of the rejections are caused by the faults we have just mentioned, and we cannot too strongly recommend to those charged with the manufacture of hollow projectiles to allow the grey metal, when very hot, to remain a short time in the ladles; especially metal obtained, as it generally is for this purpose, from impure ore.

entirely grey has been obtained by means of charcoal from refractory and rather pure ores, it becomes more liquid, throws out less graphite, and is more suitable for making shot of an even surface; but small cavities may still be seen at the superior pole.

Of casting hollow Projectiles.

The moulds for hollow projectiles are made of sand; clay was formerly used for the cores, but they are now also made of sand; at least it is to be hoped that this improvement will be generally adopted. Pit sand should be used for moulds; river sand has too little adhesiveness. It should be of a fine grain, and of such a consistence that it may stick together when pressed in the hands. If it contain too much earth it adheres to the casting, and gives it a rough surface: if too pure it has not sufficient consistence, and the moulds are easily broken and spoiled. The sand should however be as pure as it is possible to use it, in order that the surface of the casting may be more readily cleaned.

Sand which is too earthy may be easily corrected by the addition of dust from charcoal, coke or mineral coal, a very refractory substance which may be obtained perfectly fine, and which resists, in the strongest manner, the tendency to vitrification, and consequently to the adhesion of the sand to the metal. The dust of coke or of mineral coal is preferable to that of charcoal, and should *always* be used to give projectiles a fine surface. Calcination also furnishes the means of preventing the sand from adhering too strongly to the metal; and this method is naturally employed, by making use of the sand in which other castings have been made. It is necessary to mix it with fresh sand in order to give it greater consistence, and at the same time a certain proportion of the dust of coke or of pulverized coal is added.

Before using sand it is dried, then sifted, and properly worked and moistened: the quantity of water added should be the least possible to make it fit for use, because too much moisture may cause the casting to fail; there is however no danger to the workman in an excess of moisture, because the steam finding little resistance, passes easily through the sand without causing explosions, which often occur, in using clay moulds.

Of Sand for Cores.

Sand for cores should of course contain more clay than that used for moulds, in order that after having been dried the cores may be so hard as not to be easily injured, and that they may adhere properly to the spindles. If the sand contain too much clay the core would not dry thoroughly without long exposure to a very high temperature. This inconvenience may be remedied by the addition of pure sand, or of coke dust, and by drying a second time.

In general, the quality of the sand and the degree of heat to which the cores should be exposed are dependent on each other. It is easy to succeed by subjecting them a sufficient length of time to a high heat; but the results are more certain, the operation is quicker and less expensive, when the sand is of the proper quality, having sufficient consistence not to be easily separated, and at the same time not retaining water with so much force as to require exposure to a very high degree of heat. If sand of this quality is not to be found on the spot, it may be composed by mixing the different kinds, or even by adding clay, provided however that it does not contain too great a proportion of calcareous matter, the proportions of the mixture are

soon determined by trial. But it is especially important to regulate the operation of drying according to the quality of the material used; when the casting fails and the projectiles are full of flaws, it may always be attributed to the presence of moisture. Whatever be the quality of the sand, it is prepared as described under the preceding head; that which has been once used cannot be again employed without the addition of fresh sand.

Of Clay for Cores.

Although cores are now made of sand, we shall say a few words on the preparation of them from clay, and consequently on that of the clay itself: our remarks will apply also to the preparation of the nucleus of cores made of sand.

Argillaceous earth retains water with greater force, shrinks more in drying, and has a greater tendency to crack, in proportion, as it contains a greater quantity of alumina. The use of grey earths should be avoided, because they have not sufficient consistence; nearly all the earths which effervesce with acids are of this sort.

The clay is first dried, then pulverized, or rather beaten with a bat, to break the lumps, and sifted for the purpose of separating the pebbles, it is then moistened and well worked, adding at the same time about one third of horse dung. The viscous liquor contained in the dung prevents the clay from cracking, diminishes the shrinking, makes it less compact, less hard after drying, and easier to break when the shell is to be emptied. The clay used for the core of the *eye* should be passed through a silken sieve, and mixed with a smaller proportion of dung; the same may be said of that used for the last coats of cores made after the old method.

Of the models of Hollow Projectiles.

The globe, or model, is generally made of copper: it consists of two hemispheres joined by a tongue and groove, in such a manner that they touch each other only on the exterior circumference; the inner part should be bevelled at a large angle: this is an essential point, for by this form the seam of the projectile is made thinner than it would be if the two hemispheres touched each other on a larger surface. The metal should be from three to four lines* thick, so that it may not yield when the sand is rammed on it. The diameter of a model for any calibre is variable, on account of the different degrees of expansion and contraction of different kinds of cast iron: it always expands in passing from a fluid to a solid state, and afterwards contracts in cooling. This increase and diminution of volume varies not only in different foundries, but also in different kinds of metal obtained in the same furnace by working it differently.

In general the grey metal expands more in crystallizing, or contracts less in cooling, than the white metal; the former may give projectiles of too great dimensions, whilst those cast with white metal in the same moulds may be too small. The diameter of the model should therefore be regulated according to the quality of metal which, in the furnace employed, appears to be most fit for the object in view, and most frequently obtained. On the other hand

*The French measures are retained in this article without reduction to the corresponding dimensions in English measures, because the former bear nearly the same proportion to the latter that the corresponding calibres bear to each other in the French service and in ours; besides they are easily reduced if necessary, to English measures; a French foot being equal to 12.79 English inches, very nearly. Trans.

it advantageous for the service that the diameters of the projectiles should agree as nearly as possible with those of the largest gauge used in the inspection; which diameters, for twelve inch mortars and twenty-four and sixteen pounder guns, differ eighteen points from the calibre of the bore, and for other pieces, one line. It is only by trial, making the globe at first too large, that we can obtain the proper diameter, which should be such that the greater number of projectiles shall not pass through the intermediate gauge. To obtain this result it often happens that, for large calibres, the diameter of the model should exceed, by several points, that of the large gauge.

The addition of the dust of coal, or coke, to the sand facilitates the cleaning of the projectile and makes the surface more even, consequently the diameter smaller, so that a greater number pass through the intermediate gauge, or even through the small one. If water be poured on the iron whilst hot, it contracts more. (*See casting and finishing Projectiles.*) Hence the necessity of being well acquainted with all the circumstances of the manufacture, when by the first trials, the dimension of the model is to be determined; if too small it cannot be corrected by a coating of tin, as has been sometimes attempted; it would be necessary to procure a new one, which occasions a considerable expense.

The model should be turned and finished in all its parts with the greatest precision. It was formerly the custom to flatten the models of all projectiles very much at the poles: it was thought that the metal contracted more in the horizontal than in the vertical direction. We have for a long time contended against this opinion. Experiments have proved to us that the alleged difference in the contraction of the metal does not exist. If projectiles, *of a medium weight*, moulded with spherical models, are sometimes elongated, it is to be attributed solely to the unskilfulness of the workmen, who have not sufficiently compressed the sand about the lower pole: it then happens, especially in the case of large projectiles, that the weight of the metal, causing the sand to yield, produces the elongation in question. When the workmen have the requisite degree of skill and intelligence, the models of all hollow projectiles, below the calibre of ten inches, should be perfectly spherical: by flattening them we obtain many flattened, and ill shaped, projectiles. If, on the contrary, the models are spherical, the workman soon learns to ram the sand properly, so that the number of elongated projectiles is very small, whilst nearly all the others are perfectly spherical. Workmen generally prefer flattened models, because they are more afraid of obtaining elongated projectiles which will be rejected, than of producing a quantity of others more or less badly made.

The models of ten inch and twelve inch shells may be flattened from four to six points, as the sand cannot always be rammed sufficiently to prevent it from yielding to the pressure of these heavy castings. This explanation of the cause of the elongation of projectiles overthrows an absurd opinion, which has generally prevailed; there are, however, other causes of elongation which will be explained under the head of moulding.

The upper hemisphere of the model is pierced with a round hole intended to receive an iron spindle; in twelve inch shells the hole is nine lines in diameter; the length of the spindle is seven inches, four lines: it consists of three parts; one part is cylindrical and cut with a screw thread; it serves to fix to the hemisphere of the model a sort of handle by means of which it is managed: the second part is a truncated cone, all the dimensions of which are perfectly similar to another conical part on the spindle of the core, and it serves to prepare for the latter a lodgment in the sand. The third part is

nearly cylindrical, having also a diameter equal to that of the spindle of the core. In speaking of the flasks, we shall return to this subject. The upper hemisphere of the model of shells is pierced besides with two rectangular holes for the ears. Their position and form have undergone several variations; the following is the usual manner of tracing them. On a diameter perpendicular to the axis passing through the eye, lay off on each side three inches three lines, draw perpendiculars at these points, and with the radius of the twelve inch shell increased by that of the hole in the ear, cut the two perpendiculars at points which determine the centres of the holes: all shells being similar figures, the centres of the holes will be always found on the same radii. The diameters of these holes are laid down at four lines six points, for the twelve inch shell; three lines nine points, for the ten inch, and three lines three points for the eight inch. In practise it is necessary to make them a little larger, to afford the requisite play to the rings. It is essential that the mortices for the ears should be large enough to admit of their remaining in the sand, with the rings, after the hemisphere has been removed. Each ear is divided into two parts, which are generally joined by a tenon, so that they may be easily withdrawn in succession, without displacing the ring.

The ears placed as we have said, on a great circle, ought to fit accurately on the sphere, and form with it a continuous surface. The rings which are semi-elliptical, should be made with great precision, and finished with the file, so that the brazing, which is on the straight part, may not be visible. They are made of iron wire about two-fifths of an inch thick: it is necessary that they should play freely in the ears, and should fall down entirely on the surface of the shell. The diameter of the hole which they make should therefore be greater than their own: this is effected by enveloping them with a coat of clay, which should be quite round and well dried. When the shell is cast, this clay being removed, the ring has the requisite play.

The lower hemisphere of the model is also pierced with a hole which receives a piece called the *false spindle;* its dimensions are arbitrary; it is pierced at the inner end, with a mortice which receives a key. The other end is also pierced with a square hole in which is introduced a bar of iron or small ruler. The object of this spindle is to prevent the model from being detached from the mould when the flask containing it is raised; for this purpose a bit of wood is slipped under the rule; this acting like a wedge against the edge of the flask raises the rule and consequently presses the mould against the sand.

Of the Spindle of the Core, and of the Pattern.

The spindle of the core is divided into two parts by a swell several lines in height, in the form of a truncated cone, the base of which nearest to the core, has a diameter only three or four points less than the greatest diameter of the eye. The diameter of the other base is a little smaller than the first; in order that the spindle of the model, which should be perfectly similar to that of the core, may be withdrawn from the sand without causing any derangement of the mould. The dimensions of the part of the spindle opposite to the core are determined by the height of the flask, as we shall see further on. The part which supports the core, added to that which forms the eye of the projectile is equal in length to the distance from the upper circumference of the eye to the bottom of the shell, less a small quantity, and varying with the calibre: it is not important whether it be a little longer or a little shorter; the only essential point is that the swell and the part of the

spindle opposite to the core, should be perfectly equal to their corresponding parts in the spindle of the model, and that the length of the swell be strictly determined according to the dimensions of the flask. We shall return to this subject.

The spindle may be either solid or hollow. Solid spindles having one or two deep grooves extending through their whole length, are also pierced, at the part which supports the core, with two rectangular holes in which pieces of slate are placed, to support the clay. In these grooves are placed straws to facilitate the disengaging of the gases. Hollow spindles intended principally for cores of sand, are pierced with five or six holes two lines in diameter. I think the latter kind preferable; they are besides easier to make, lighter, and less apt to spring than the solid spindles; they are made of sheet iron fifteen or twenty points thick, cut into pieces of proper size and rolled hot on a mandril. It is not necessary that the edges should be brazed together; it is sufficient that they join. The swell of the spindle is made by a ferrule which is brazed on. It is essential that the ferrule and all that part of the spindle which is to be similar to the spindle of the model, should be turned to the exact dimensions required. Both kinds of spindles should be flattened at the end opposite to the core, in order that it may enter into a crank; in that part there is also a hole to receive a key, when the core is placed in the mould. The other end should have a small conical indentation to receive the point of the screw which serves to fix the spindle in the lathe.

The dimensions of the core are determined by means of wooden patterns, of which there should be three, because the core is not finished at one operation. The radius of the first pattern differs ten lines, of the second four lines, from that of the core when finished; the third should give an exact section of the core, including that of the eye. The pattern is very easily drawn, for all its dimensions are given by those of the shell. A similar profile, made of iron, a gauge, and calibres for the eye, serve to verify the dimensions of the core. Before entering into the details of moulding, we shall describe the flask.

Of the Flasks.

The flasks are boxes of wood, or of cast iron, without bottoms, divided into two unequal parts, each of which contains the mould of a hemisphere, and which are joined together by dowel pins, wedges, hooks, or small bolts and keys: the connexion by means of screws seems to me very defective.

The thickness of the boards of which wooden flasks are made should be from fifteen to eighteen lines for ten and twelve inch shells, and from ten to twelve lines for other projectiles. Wooden flasks are generally square; three of the angles are partly filled by triangular prisms of wood, to increase their solidity and diminish their capacity. The size of the flasks should be such as to leave a space of about an inch, or an inch and a half, around the model: if this space were greater, the preparation of the mould would require too much time; it would increase the expense, and at the same time impair the result of the operation, because the sand always yields more or less to the expansion of the metal, which is greatest at the points of least resistance, and this effect will be greater where the sand is thicker, the difficulty of ramming it firmly, being then increased. The part of a flask which contains the mould of the hemisphere in which the eye of a shell is placed, we shall call the *drag*; the other part the *cope*. The former which is ten inches eight lines deep for twelve inch shells, and to which the slides that receive

the wedges are adapted, contains a cast iron traverse, reinforced in the middle of its length, and pierced with a hole. The depth of this hole, or the thickness of the bar, or traverse, is four inches; its width is arbitrary. The hole, which is nine lines in diameter, receives the spindle of the model, the swell of which should rest exactly against this bar, as should also the swell of the spindle of the core. Accuracy in the position, and consequently in the thickness, of the sides of the projectile, depends therefore on the precision with which the bar is made and fixed in its place, as well as on accuracy and perfect identity in the form of the spindles.

This bar, or traverse, is therefore the most important part of the flask. If it were bent up or down the thickness of metal at the eye would be too great or two small: if its position were deranged laterally, the position and direction of the eye would vary accordingly. In verifying the flasks therefore the principal attention should be directed to the position, dimensions, and solidity of the traverses. They are let in their whole thickness into the sides of the flask, and kept in their places by screws, straps and keys. The depth of the drag is generally determined by the semi-diameter of the model added to the height of the swe'l of the spindle, and the thickness of the traverse. The sum of these three dimensions is ten inches eight lines for a twelve inch shell. The depth of the cope is equal to the semi-diameter of the model increased by two or three inches allowed for the thickness of the coat of sand: that depth is consequently from eight inches to nine inches in the example we have chosen. It may without inconvenience, be greater; but no variation can be allowed in the depth of the drag, unless corresponding variations are made in the spindles or in the thickness of the traverse.

When the flask is so arranged that the shell is cast with the eye downward, it is necessary to give the cope a greater depth than it would require if the shell were cast with the eye uppermost; because in the former case the sand in the cope is supported by the board on which the flask rests, but not in the latter.

Cast iron flasks have a round form with a swell or projection at the part where the gate is placed. The sides may be vertical, or may consist of two truncated cones placed base to base, giving a swell in the middle of the height. The two parts are connected together by dowels and ears through which key bolts pass. The traverses should be cast separately, and the holes drilled cold, to secure greater accuracy. In casting them at the same time with the flasks it would be impossible to avoid slight variations in all their dimensions; cast iron flasks are far preferable to wooden ones, because they can be better joined, and are much less subject to derangement, and the traverses can be adjusted in them with greater precision and solidity. We have already said that there is an advantage in having the coat of sand thin; but in that case the wood, affected by the heat and steam, becomes warped, which always causes errors in the dimensions of the projectile: hence another reason in favor of cast iron flasks.

The *gate* or channel by which the metal is conducted into the moulds is curved and terminates at the extremity of a horizontal diameter of the mould. It is called a *heel gate*, and it is formed in the sand by two pieces of wood, one of which, placed vertically, has a conical form: the diameter of its greater base is two and a half inches, that of the lower base is nine lines for twelve inch shells, and its height is necessarily equal to that of the upper portion of the flask: the other piece of wood which forms the heel, is

placed horizontally, meeting the model on one side and the vertical piece on the other; its ends are therefore cut to correspond respectively with the surface of the vertical piece and with that of the model; its form is flattened. The first of these pieces of wood is called simply the *gate*, the other the *heel*. In describing the process of casting we shall mention the several instruments made use of; but we must first say a few words on the subject of the lathe used for forming the cores made of clay, and the nucleus of those made of sand.

(TO BE CONTINUED IN OUR NEXT.)

On Calcareous Cements. By James Frost, Civil Engineer.

No. IV.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Having seen the intense affinity between lime and water, we will now endeavour to examine the superior affinity between lime and carbonic acid; with which lime is always found naturally and definitely combined in the proportion of twenty-eight lime and twenty-two carbonic acid. It is also, generally or always found mixed, and seemingly in combination with other substances; for, in the purest white Italian marble I have always found some minute silicious particles. Yet, carbonate of lime we shall hereafter find is never chemically combined with those other substances—whatever may be the hardness or specific gravity of the mass;—and as this is seemingly a position of some importance in geological investigations, it will be hereafter adverted to in connection with another part of equal importance, when we have had the advantage of considering some other combinations of lime.

In England, lime is generally procured by calcining the carbonates in two different modes. The one and most frequent, is the cheapest and easiest in practice, but the lime obtained in this way is generally found inferior in quality to that obtained by the more troublesome and expensive process.

As lime of as good quality may be obtained by the easier process, we will endeavor to describe the necessary conditions. In the first mode, the carbonate is interstratified with the smallest and cheapest coal, in inverted lime kilns, and the fuel being in actual contact, acts with the greatest effect. The kilns are of the cheapest construction and maintenance, and being daily emptied of a portion of calcined lime, and daily charged with an equal proportion of fresh materials, the business is regularly conducted in the easiest manner—but the lime thus obtained is of a variable quality from some causes which must be explained in order to be avoided.

In the second mode the carbonates are piled in kilns so constructed that the fuel is burned in furnaces, and only the flame thereof admitted into the kilns to calcine the lime. In this mode, the coals used are large and of the dearest kind; more of them are required, as they do not act with so much effect; constant attendance is required night and day during the calcination; the kilns are more costly in construction and maintenance, and much expensive iron work is required.

If we calcine some limestone in an iron tube, or retort, set in a brick furnace, and then allow the retort to cool very slowly, while another portion of limestone is being calcined in a similar retort which is connected by an iron tube with the first so that the carbonic acid gas may be conducted

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into the first retort, it will be there absorbed by the hot lime, which thus becomes uncalcined as it were, and is recarbonated more or less according to the care taken in conducting the experiment.

If we now enquire why the first mode is so uncertain, we shall find that the kilns are commonly constructed about equal in diameter and depth, and that the most careful workmen find it difficult. or impracticable, to draw the calcined lime, so that portions of it do not intermix with portions of the uncalcined and of the fuel. In which case, a portion of uncalcined lime escapes calcination, and a portion of that which is calcined becomes more or less uncalcined, and a very irregular article is thus produced.

If lime kilns were always constructed of two or three diameters in depth, careful workmen might always draw without intermixing the calcined and uncalcined strata in the kilns, and a good article would always be produced at the least expense of time and trouble, and that this mode will succeed in practice with any description of limestone, will be apparent, when we state that the most difficult carbonates to calcine, are those employed in the production of cements, which must be sufficiently calcined to become tender for grinding, while from their chemical qualities they are easily fusible with a small excess of fuel; now as these carbonates are well calcined in such kilns, it must be evident that all may be so, as no others can, from their nature, be so difficult to manage.

In either of the two modes of calcination the lime is allowed to cool in contact with atmospheric air, and this we have already seen is essential to the production of lime. For, if having calcined lime in a reverberatory furnace, wherein coke has been used for fuel, and if then a fresh supply of fuel be added, and the supply of fresh air prevented to the furnace and to the chimney, by closing the apertures thereto, and the lime be thus allowed to cool, it will absorb and condense much sulphuretted hydrogen as well as carbonic acid gas, and when cool, will be incapable of slacking with water, and if pulverised and tempered with water, it will set as cement, for a long time thereafter, exhaling the peculiar odour of sulphuretted hydrogen.

If, when the lime is about to be thus cooled in a reverberatory furnace, a portion of pine wood is added to the other fuel, the lime when cool, will be found nearly black throughout its whole substance by the vapour of carbon which has penetrated and been condensed therein; a black cement has been thus obtained, coloured probably, as some black marbles are found by analysis to be; the Kilkenny or black Irish marble, owing its color to its containing two per cent more carbon than white marble, which always holds twelve per cent combined with oxygen in its carbonic acid, and Kilkenny marble holds only two per cent more, but being uncombined, it acts as colouring matter, showing what a great difference in sensible qualities is made by a small difference in the quantities and chemical arrangement of the elements of solid bodies.

Every different species of carbonate requires a different quantity of fuel for its due calcination, the argillaceous varieties requiring a quantity very nearly proportioned to the carbonic acid in them; hence, the inference is, that the heat evolved is essentially employed in converting the acid into permanent gas. Thus, two measures of small Newcastle coals, are required for the calcination of ten measures of Thames chalk, and is sufficient for fifteen measures of Roman cement stone; but as this latter substance is about one third ferruginous and argillaceous matter, it would seem to require the expenditure of little fuel for that portion. As a measure of chalk is about

twice as heavy as a measure of coals, it follows that, ten pounds of coals are required to calcine 100 of carbonate, or one pound coals to 4.4 pounds carbonic acid; but as eighty-four pounds of the live coals would heat and evaporate twelve cubic feet of water, one pound of coals would heat and evaporate nine pounds of water. We thus find by rather a rough process, but from facts correct enough for general reasoning, because derived from operations conducted on the large scale, that the latent heat in carbonic acid gas, is about double the latent heat of steam.

If 37 parts hydrate of lime is placed in contact with 22 carbonic acid, the nine parts of water in the hydrate will be all expelled, and the carbonic gas combining in a solid form with the lime gives out its latent heat, which being taken up by the water, it escapes in the form of vapour, or steam of superior elasticity to the atmospheric pressure, although its temperature is insensible, this very curious or rather wonderful fact, and others, hitherto, I believe, wholly unnoticed, we shall see amply verified when we examine the properties of cements.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

On the Production and Manufacture of Salad or Table Oil in the United States.

The following remarks are intended to apply to that strip of the United States, which is comprehended between the latitudes of Cape Hatteras and Boston bay, extending westward.

Although there is no part of this extensive region in which the olive tree could be cultivated, except when protected by the green house, and therefore, the inhabitants are denied the advantages of this useful tree, it does not follow, that nature has denied them the means of procuring an excellent and pleasant substitute for olive oil, and one that could be brought into market at a moderate cost. Between them and this enjoyment, ignorance is at present a barrier, and in this case, as in many others, this is strengthened in its result, by prejudice.

In French Flanders, the farmers cultivate in large fields, and to a great extent the *White Poppy*. The seeds of this plant are collected and bruised in some way, and an oil expressed from them, which in all respects resembles olive oil, and is the source from whence is derived a large proportion of what is consumed in Paris. The poppy oil so much resembles olive oil, that strangers who visit Paris take it for that oil. These are facts as regards the consumption.

Of the state of this important branch of husbandry and manufacture, we the people of the United States know nothing. How is it cultivated, the seed collected, the oil preserved? Does the land require to be sown every year, or does it seed itself? What sort of a mill does it require? What is the product in oil, or in profit? In short, we have every thing to learn, except that, incidentally we have heard that fifty pounds of beet cake, after the sugar maker has got what he wants out of it, and ten pounds of poppy seed after the oil maker has done with it, will keep ten sheep a day and fatten them.

We know that since the article on beet sugar appeared in the Journal of the Franklin Institute, requesting those who knew any thing of the subject to favour the editor of the Journal or the public with information, a well

qualified agent has been sent to Europe to acquaint himself with the whole agricultural and manufacturing business that produces sugar.

On the present occasion, we invite the patrons of our country's industry and resources, to communicate for publication, what they know on the above interesting branch of French husbandry, &c. And we therefore request the wealthy and patriotic, to consider whether the case of oil does not resemble that of the sugar from the beet, and whether the best course would not be to adopt a plan similar to that which the friends of beet sugar have chosen.

The time will come when American parents will send their sons to Europe and to other foreign places, to learn the manufacture of beet sugar, of oil, and such other branches of the arts not possessed by us, in the same manner and with better reason that they now do to have them learn medicine and surgery.

June 4, 1836. J. R.

Civil Engineering.

Some suggestions on the Location and Grading of Rail Roads.
By Thomas Earle.

In the location and grading of rail roads, it is usual to reduce the road in all parts, as near to a level as possible, and in effecting this object, to make many curvatures, some of them of small radius. Thus, a very considerable increase of expenditure and of distance is occasioned, which appears to me inexpedient.

It is true, that if a rail road could be made perfectly level, or very nearly so, without being unreasonably curved, such a road would be better than an undulating one: because the locomotive engines would require to be transported less frequently over the ground, to convey a certain quantity of goods on such a road, although the expenditure of steam for conveying the train, independent of the locomotive, would be as great on the level road as on the undulating one. A perfectly level road, however, is impracticable in most parts of the country, except at an expense far exceeding the value of the benefit gained. Hence, it is probable that few roads will hereafter be made, without ascents and descents, in some parts, at the rate of forty to fifty feet per mile.

Such ascents being admitted in some parts of the road, the locomotives will take no greater trains than they can draw up those ascents. Hence, it will be useless to make excavations, embankments, and curvatures, to avoid other ascents of the same grade.

A locomotive will take a train up an ascent of twenty-one feet to the mile, and down a descent of the same length and grade, with precisely the same expenditure of steam, if it be constantly used, as would be required to take the same train over the same distance, on a perfect level. If the train were such as to require for drawing it on a level, a pressure of steam on the piston of thirty-six pounds to the inch, above the atmosphere, then on the ascent of twenty-one feet per mile, it would require sixty-three pounds per inch, and on the descent of the same grade, nine pounds per inch, making the average thirty-six pounds or the same as on the level.—Thus, $63+7=72\div2=36$ pounds.

If, however, the road were composed of alternate ascents and descents, at the rate of from thirty to forty feet per mile, with but short levels between them, the engine would transport such train as it could draw on the road,

with a *less* expenditure of steam than it would require to transport the same train on a level. This might be effected by shutting off the steam from the piston on descents, and suffering the train to progress by its own gravity. The saving in this case, compared with the other, would arise from dispensing, on half the distance, with the amount of steam, viz: about fifteen pounds to the inch, which is required to overcome the external resistance of the atmosphere. There would also be a further saving from the constant use of high steam, if the supposed fact be correct, that a certain volume of steam under a pressure of one hundred pounds to the inch, can be produced with less than double the fuel which is required to produce the same volume of steam under a pressure of fifty pounds to the inch.

And the result, as to the expenditure of steam, will be equally favourable on ascents and descents, as great as fifty feet to the mile, (excepting the before-mentioned inconvenience of transporting the engine a greater number of times over the ground) as with ascents and descents of a less grade, provided the inclined planes be not so long as to require the checking of the velocity of the train, by artificial means in descending: for the momentum acquired in the descent, will continue the motion on the succeeding level or ascent, until the power expended in overcoming gravity in ascending, is re-imbursed.

It is further to be observed, that if there be admitted on a road, inclined planes of several miles in length, and of a certain grade, *shorter* planes of a higher grade may be admitted on the same road, without inconvenience, because the momentum acquired by the velocity of the train, before commencing an ascent, will give considerable assistance in overcoming it. A velocity of twenty miles per hour would give a momentum, if I have estimated it rightly, sufficient to raise the train about twelve feet in perpenticular height. Thus a road having long inclined planes, graded at forty feet per mile, will admit those not exceeding two thirds of a mile in length graded at fifty feet, or not exceeding one third of a mile in length, at sixty feet.

Hence, it is unnecessary, on long inclined planes intended for locomotives, to make them of uniform ascent, as the momentum gained where the ascent is below the average, will assist in overcoming the resistance where it is above.

The making of curves in rail roads, to avoid slight ascents and descents, is productive of several inconveniencies.

1. It increases the cost of the road, by its greater length, and proportionably greater expenditure for land, foundation and rails.

2. By the increase of length, the time of travel and the expenditure of steam, is increased in nearly the same proportion.

3. The expenditure of steam is further increased, in overcoming the strain and friction occasioned by the operation of the wheels on the curves, the power expended not being re-imbursed, like that expended in overcoming ascents. The resistance on short curves upon a level is found to be greater than on a straight ascent of thirty feet per mile.

4. The wear of carriages and locomotives, and their liability to break or become disordered, is increased by the greater distance, and by the strain on the curves, which racks every part of the machinery to a degree much complained of by practical engineers.

5. The wear of the rails, and their liability to disorder is increased.

6. The danger of running off the road is increased.

Hence, a road should be made as straight as possible, without a great increase of expense, and without encountering ascents unreasonably great.

I will add a suggestion in relation to cars for burthen. The greater the load carried by each car, the less will be the weight and cost of cars, compared with the goods transported. Materials increase in strength in proportion to the cube of the diameter, while the weight and volume increase in proportion to the square. Hence, the cost of materials, workmanship, and transportation of cars, will all be reduced, by using as strong cars with as great loads as the road will permit. A further advantage in strong cars and heavy loads to each, will be found in shortening the train, and thus decreasing the strain in turning curves. As locomotive engines with six wheels are used, weighing with their water and fuel, eighteen or twenty thousand pounds, I can see no serious objection to the use of burthen cars of four wheels, weighing with their load, five and a half or six tons, with a proportionate increase of weight when six or eight wheels are used.

Objections have been made to the matter contained in the forepart of this essay: 1. That on an undulating road, the steam must be blown off and wasted on descents, owing to its superabundant quantity: 2. That although none were used on descents, the pressure of steam could not be kept up sufficiently, because none would pass through the flue to aid the draught. The two objections are contradictory of each other. They can both be obviated by proper power in the boiler, with an adequate steam chamber, and by proper attention to the supplies of fire and water. They are not felt as serious inconveniencies with the best engines on the Columbia Rail Road. There is one plane on that road of upwards of ten miles, and another of seven miles, where the cars will descend by their gravity. The engineers cause a fresh supply of water to be put in the boiler at the head of the plane, and no fuel till near the foot of it, and thus they avoid the necessity of blowing off steam. If they were to add fuel, they would have to discharge steam, which shows that both objeetions are of little importance, in comparison with the advantages of a straight road at a diminished expense.

If it should be found that without particular attention to the addition of water and fuel on descents of moderate length, where the train progresses by gravity, there will be an inconvenient surplus of steam, the difficulty can be obviated by the use of a damper to check the draught.

Physical Science.

Proposed forms of diagrams for exhibiting to the eye the results of a register of the direction of the wind. By A. D. Bache, Prof. Nat. Philos. and Chem., Univ. Penn.

My attention has been recently recalled to the subject of diagrams for showing the results of a register of the direction of the wind, by the first number of a meteorological publication,* received through the politeness of its author, W. R. Birt, Esq. of London. At one of the early meetings of the joint committee of the American Philosophical Society and Franklin Institute, appointed in 1834, I laid before the members several plans for the purpose above referred to. These, I propose now to make public in the

* Tabulœ Anemologicœ, or tables of the wind; exhibiting a new method of registering the direction of the wind, &c. &c. By W. R. Birt.

hope that one or other of them may prove acceptable to meteorologists. They exhibit to the eye the results of observations at the same or different places, thus facilitating the study of their connexion. One of the plans was considered preferable to the others by my colleagues of the committee, but as it may not be the most convenient under all circumstances, I have presented the varieties of the register as laid before the Committee. The scheme shown in fig. 4, plate 1, will be found to resemble in appearance that proposed by Mr. Birt; but the principle will be seen on examination to be entirely different from the one adopted by him.

The figures are placed in the order in which the methods suggested themselves. The first is probably the most natural form of diagram, and was the first which occurred to me, while the others are successive modifications growing out of difficulties, or objections, which appeared in studying the subject. The first was preferred by my colleagues of the committee as best accomplishing the object, while the last is adapted to the ordinary form of diagram used to represent the variations of the thermometer, barometer, &c.

A register of the wind should not only show its direction at the time of observation, but the direction through which it may have passed when changing from one point of the compass to another. A diagram illustrating such a register must admit of an easy mode of expressing the results, and the less artificial this method the better will it answer the purpose of addressing the eye. In his valuable meteorological essays Professor Daniell has adopted a method of representation first used, I believe by Mr. Howard. A horizontal line is drawn and points assumed upon it at convenient, equal distances, to represent the times of observation. Above this line points are assumed at regular intervals, to denote the points of the horizon between west and east, by the north. Supposing the cardinal and ordinal points only to be marked; the north west point will be on the left hand, and the east on the extreme right. The positions assumed for the points of the horizon will of course depend upon the degree of nicety to which it is intended to note the direction of the wind. From any one of these points to one of those in the horizontal line first assumed, representing the times of observation, a line being drawn represents the direction of the wind. A similar arrangement is made below the first horizontal line or at the foot of the diagram, if it is also to exhibit the state of the barometer, thermometer, &c., for the points from west to east, passing through the south. This method does not admit easily of expressing the direction through which a wind has changed, and the lines of direction of the wind, sometimes cross each other at such acute angles as to render it difficult to trace them. For example, when at the close of a month the wind is north westerly for several successive days, the lines expressing this fact cross the whole figure. They meet other lines sometimes quite obliquely, and being but slightly inclined to each other, the eye does not readily follow them. These remarks are not offered in the spirit of criticism, but merely to point out why I thought it advisable to obtain a different scheme of registry.

The ordinary method of representing the rise and fall of the thermometer or barometer, is a natural one; equidistant points on a horizontal line being taken to represent the times of observation and the perpendicular lines drawn through these points, or corresponding ordinates, being made proportional to the height of the column of mercury. In like manner the wind being registered with reference to the points of the horizon, the natural system of representing it is to assume a system of concentric circles the in-

tervals between which shall correspond to equal intervals between the times of observation, and the angular divisions upon which shall correspond to the rhumbs. Such a scheme is represented in figure 1, plate 1. In order to bring the figure within the compass of the page, it has been necessary to make it so small that it does not fully show the advantages of the plan. A diagram in which the outer circle is seven or eight inches in diameter admits of entire distinctness, when observations are not more frequent than four times during twenty-four hours, even at the season when the wind is most variable. Where observations are frequent, the interval between the concentric circles may conveniently represent a day, the first circle corresponding to twelve o'clock at night, on the last day of the preceding month, and the second to midnight of the first of the month, and so on. The observations at intermediate hours will be placed in their appropriate positions between the two circles just referred to, and the registry will be carried on in a similar manner throughout the month. In the case actually represented, fig. 1, plate 1, the regular observations were at 3 P. M. of each day, and I have drawn the concentric circles, represented by the finer lines, to correspond to this time. The intermediate observations when a change of wind required their use, have been placed within or without the several circles, according as they were made before or after 3 o'clock of the particular day to which the circle corresponds. The variable month of April has been selected for representation, as putting the diagram to a severe test. The circle having been divided as shown in the figure, so as to point out the cardinal or ordinal points, a dot is placed on that radius corresponding to the point from which the wind blows. Thus, on the 1st of April, 1836, at 3 P. M. the wind at Philadelphia was S. S. W. the dot numbered 1, is on the first circle recking from the centre, at the intersection of a radius, which would bisect the angle S-W. *c.* S. On the 2d at 3 P. M. the wind was N. W. a dot is therefore placed to denote this on the second circle, at the intersection of the radius N-W, *c.* The table from whence the direction of the wind was taken* shows that the wind passed from the S. W. to the N. W. through the west as is expressed by the curve 1, 2, passing through the west point. On the 3d the wind was S. W. as denoted by the dot at 3, having passed back by the west, which direction therefore the curve 2, 3, is made to intersect. The wind passed the S. W. to S. S. W. between the 3d and 4th, as is shown by the curve 3, 4. It remained at this point until the morning of the 5th, as indicated by the straight line from 4, when it changed by the west to N. N. W. Passing this point to the north in the evening of the 5th, it returned to the N. W. on the 6th. It is hardly necessary to trace the courses further to show how the diagram represents the results of the table, but it is probably worth while to refer to one of the cases, when the change of the direction of the wind is not through the smaller angle between its two directions. On the 10th of April the wind was N. E. as indicated by the dot 10; on the 11th, it was N. W. having changed round by the South as fully represented in the curve 10, 11, which sweeps through the angle of 270°.

One objection occurs to the curves between the times of observation, namely, that they represent the wind as gradually changing, whereas, in fact it frequently ceases, an entire calm preceding the wind from the new direction. This false impression is entirely avoided in such a case, by a system of numbers, or symbols, representing the force of the wind. These

* Kindly loaned to me for this purpose, by James P. Espy, Esq.

being placed in brackets, can not be mistaken for the numbers representing the days of the month, which it may generally be found convenient to place upon the points corresponding to the principal observation of the day. A curve being traced to a certain point, and found to terminate there a zero in brackets (0) will show a calm, and avoid this being taken for another case, which might occur in a defective register, namely, that in which the direction of the change was not noted. If the observations are frequent the curves will be traced entirely from them and will be of course, therefore, the more accurate, as the observations are more numerous. If there should be but one regular observation during the twenty-four hours, the direction in which changes take place being, however, noted, the dot will serve to point it out, and it will be easily understood that the curves merely show the angle of direction through which the change took place. The character of the weather may readily be entered on the diagram, which to accommodate such remarks should have its first circle farther from the centre *c*, than in the figure, the object of contracting which has been already stated.

Before I became familiar with the use of the first diagram, the considerable extent of the outer circles seemed to me quite objectionable and I therefore separated the monthly register into three parts as shown in figure 2. The left hand figure contains the observations of the first ten days, the middle figure of the next ten, and the right hand figure, of the last eleven days of the same month, which is registered in figure 1: The diagrams are strictly comparable as exhibiting the same results. The middle set of concentric circles is connected with the first by a dotted circle within that denoting the eleventh day of the month. On this circle, which corresponds with the tenth of the left hand figure, the observation marked on this latter is placed. Thus on the 10th the wind was N. E. as shown by the dot at the intersection of the radius N-E. *c*, on the outer circle of the left hand set. This mark is transferred to the dotted circle of the middle set and the curve traced between the dot and that, for the direction of the wind on the 11th, shows the angle through which the change from N. E. to N. W. took place. The concentric circles should commence with an inner one of more considerable diameter compared with the outer, than those on the plate, in order that the weather, clouds, &c. may be registered. The advantage of this mode of registry, or of illustrating a register in the easy comparison of results is in part lost by thus dividing the figures, an objection which led me to the scheme shown in figure 3.

A sector of a circle is taken, and similar arcs numbered I, II, III, &c. traced to denote the periods of observation. The central radius being assumed to indicate the north direction, the two extreme ones correspond to south. Proportional divisions of the angle between the lines S S', S S', give the other points of the horizon. In the figure a sector of 90° is taken, instead of the whole circle or 360°. This diagram represents the results of the same table which is illustrated by the other figures. Since there are two lines corresponding to a south direction, there are two corresponding points to be marked when the wind is south, or when it changes round by the south. Thus, on the 10th, at 3 P. M. the wind was N. E. as shown by the dot at 10 on the arc X, at the intersection of the radius N-E. *c*. On the 11th it was N. W. changing by the south through the E. &c. The curve passes across the E. and S. E. directions to the S, then from the corresponding point on the left hand line, S. S', across the S. W. and W. directions to

the N. W. This want of continuity is the only material difficulty in the use of the diagram. The system, however, is quite artificial.

By an easy transition the plan shown in figure 4, is derived from that just described. If an artificial system is to be resorted to, the convenience of using common ruled sheets employed for meteorological registers, would give it the preference.

Before describing this diagram, I propose briefly to state the means of representation adopted by Mr. Birt. This is done to show that the method now presented really differs from the one proposed by that gentleman, though in appearance resembling it. I assume, as a matter of course, that before deciding which of the two schemes would be preferable, the diagrams of Mr. Birt, to which I have before referred, and his own description, would be consulted.

A particular direction is assumed as that in which the greater number of winds at a certain place are found to blow, this, for London, is stated by Mr. Birt to be N. E. and S. W. This is called the anemonal direction, and a circle representing the horizon being divided by a diameter indicating this direction, the other rhumbs are denoted by their distances from this line. To construct a diagram for registry upon this principle, a line is drawn, representing the anemonal line, on which equal distances are laid off to correspond to equal intervals between the times of observation. Lines perpendicular to the anemonal direction are then drawn, on which to set off the ordinates representing the directions of the wind, according to the principle above stated. This amounts, in any case, to setting off a distance proportional to the sine of the angle which the direction of the particular wind makes with the anemonal direction. The assumed anemonal direction being N. W and S. E. all winds from N. W. round by S. W. to S. E. are set off below the line of anemonal direction and all from N. W. round by N. E. to S. E. above the same line. But there are still two equal sines belonging to the opposite quadrants of each of these semi-circles, so that the same ordinate would represent a N. and an E. wind, or a W. and a S. one. To distinguish between these, the changes of wind from N. E. to S. W. by the N. W. are recorded by a single line, and those between the same points round by the S. E. by a double one. In practice, the ordinates are not laid off in the strict proportion of the sines, but after the points at 45° and at 90° from the anemonal direction have been thus fixed, the distances are divided into a convenient number of equal parts.

The table of Mr. Birt includes not only the register to which I have just alluded, but one of the upper current of air, as denoted by the motion of the clouds. A register of the clouds by a peculiar nomenclature devised by him, and a register of the weather by significant letters according to a system of Lieut. Becher. Although not relevant to the comparison in hand, I mention these points that there may be additional motives to consult the interesting document to which I refer.

According to my scheme in fig. 4, plate 1, the equal distances 1, 2; 2, 3; &c. correspond to equal intervals in the times of observation. The line N. N. represents the north direction, the lines S. S. and S. S. the south. The intermediate lines, at equal intervals, give the N. E., E. &c. and the N. W., W., &c. points. The observations being shown by dots, the lines joining these latter will denote the direction of changes. A south wind is recorded in the upper and lower lines S. S. as in the case of the 13th of April, shown on the diagram. A change of direction by the south

Fig 1.

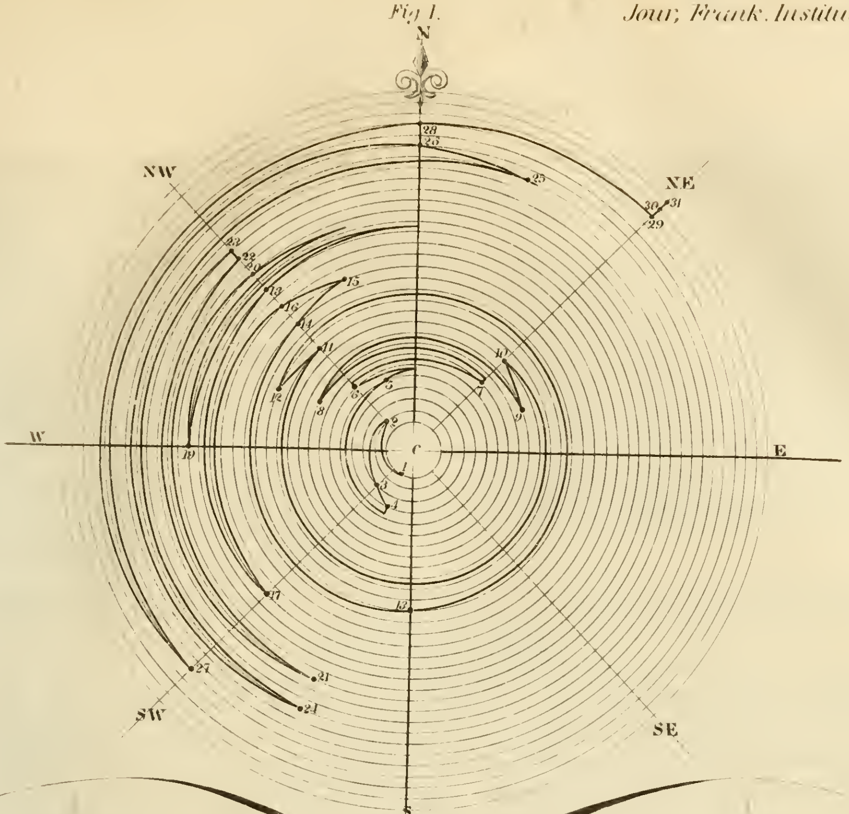


Fig 2

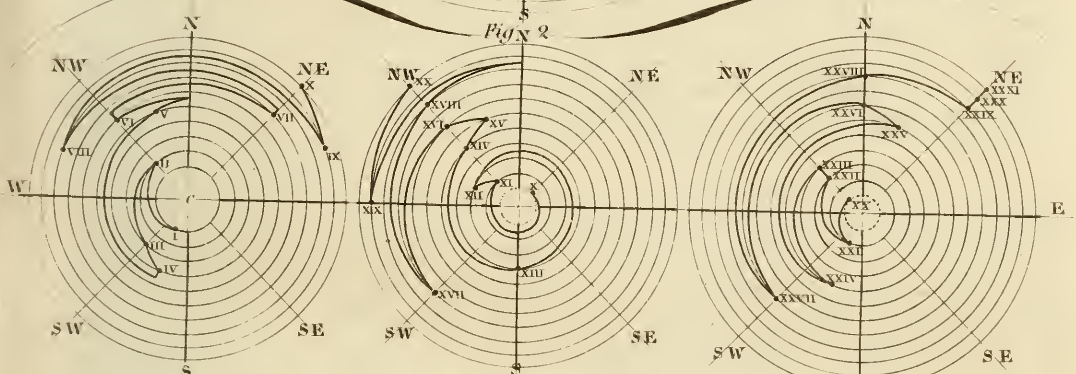


Fig 3

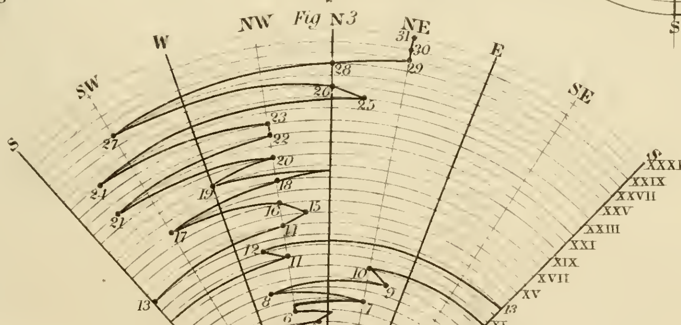
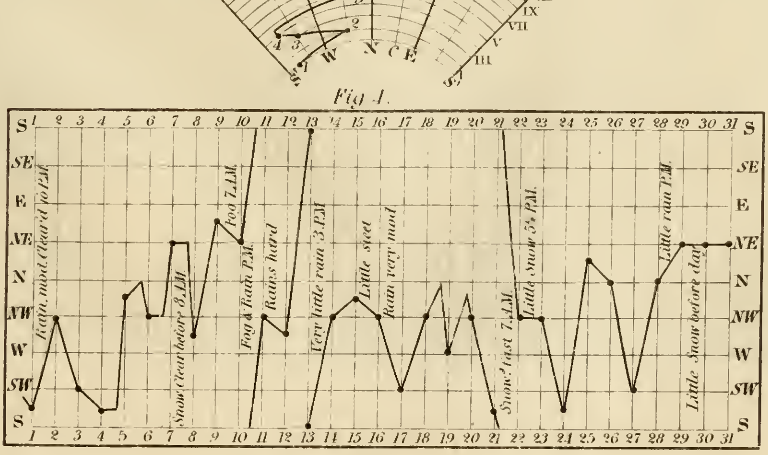


Fig 4.



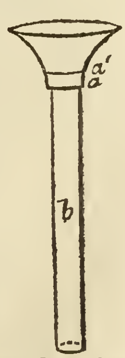
is similarly recorded, and renders the broken line joining the points registered, discontinuous. This case is shown between the 10th and 11th of the month, when the wind changed from N. E. to N. W. by the south. The eye soon becomes habituated to this form of diagram, artificial as it is, and can follow the directions of the wind in its changes, with considerable facility. The diagram, however, requires habit to render it acceptable, and I am not sure that the connexions are ever as well seized as by the first plan submitted. The extent of the diagram, to ensure distinctness, is quite inconsiderable, which is a recommendation. The record of the weather may be very conveniently made upon it, and as has been before remarked it may be formed on a sheet intended to trace the fluctuations of the heat, pressure, or moisture of the air, without any material change in the kind of diagram adapted to their registry.

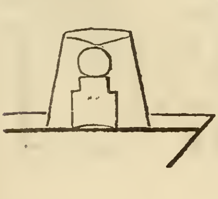
Experiments on Endosmosis. By John W. Draper, M. D., Christiansville, Mecklenburg, Va

(Continued from p. 182, Vol. XVII.)

17. The doctrine laid down in sections 13 and 14, of the condition of equilibrium of gases, on each side of a membrane, being the foundation of an explanation of all the phenomena which have as yet been noticed, require further consideration and fuller proof. Some remarks have been offered on the incompetent results which are obtained, by the use of barriers consisting of pores of large size, such as stucco plugs, sections 2, 3, 4. It is said however, that in the hands of Mr. Graham these have given some curious results, respecting the rate of diffusion of gases; experiments at once satisfactory and singular.

18. The objections above mentioned, have however, appeared to me so weighty, that I have not made use of such barriers, but resorted to liquids, which for closeness of texture, uniformity of composition, and above all, on account of our accurate knowledge of their habitudes and structure, are much preferable. They also, have given results as curious, but far more satisfactory, and though in the management of them something of that dexterity of manipulation is required which practice alone can confer, yet they are easy of repetition, never failing to give precise and comparable results. They also afford the means of prolonging or hastening the close of an experiment, which at times is invaluable; their action too, is very uniform, for a film of water so thin as to be coloured, acts as well as a mass several inches in depth, but the gases passing through it more rapidly a state of equilibrium on both sides of it is obtained in a few minutes. The following facts will serve as an illustration. Into a tube *b*, which was conoidal at its upper end, a disk of paper *a*, was fastened water tight, and then upon that was poured distilled water till it was about $\frac{1}{8}$ inch deep, the tube was next filled at the pneumatic trough as in the figure with hydrogen gas, which passed into the atmosphere through the paper roof, and the water reposing on it; but though the tube was only $\frac{3}{8}$ inch in diameter, twenty-four hours elapsed, before a column half an inch long of hydrogen, had gone out of it, and in seven days only one inch more. A common glass tumbler was filled with hydrogen gas, at the pneumatic trough, and by the side of it stood a small bottle, the height of which was about $1\frac{3}{4}$ inch, its diameter $1\frac{1}{4}$ inch, and the diameter of its neck $\frac{3}{4}$ of an inch. The atmospheric air in this bottle, being of the same temperature as

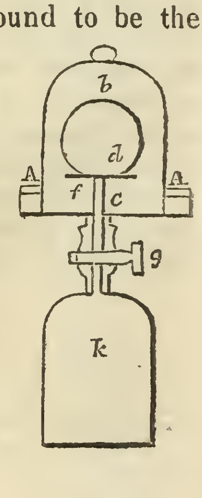




the hydrogen in the tumbler, a finger dipped in water rendered slightly viscid with soap, was lightly passed over its mouth, so as to leave a thin film stretched there, the tumbler of hydrogen being placed over it, as in the figure. In the course of two minutes, the film, instead of being horizontal became convex, and continued to be so until it had swelled into a large spherical bubble, which capped the top of the bottle; in sixteen minutes this had increased so much in size and become so thin, that it was of a dark metallic lustre, and it burst at last by swelling, so as to touch the bottom of the tumbler. During this experiment, the barometer was at 28.8. Thermometer at 66.75. Fah.

19. The rapidity of this action being proportional to the thinness of the film used as a boundary, it is obvious that the duration of an experiment may be managed, by determining beforehand, the thickness of the film through which the gases shall pass. If very thick, the time may be indefinitely long, and if very thin, indefinitely short. Nor need we be limited in reducing the thickness to the greatest extent,for it is found by experiment, that however thin the film may be, it still possesses cohesion enough, and its parts are still so close, that any thing like mechanical straining or leakage cannot take place through it. The first attempts made to ascertain the laws of movement and equilibrium of gases passing through liquid films, were made by stretching those films over the mouths of phials, as here described; subsequently, for several considerations, this arrangement was given up, the horizontal film is at first too thick, it exposes too small a surface to the atmosphere to which it is subjected, and it is not until towards the close of the experiment, that the action becomes at all rapid. Bubbles of water made sufficiently adhesive by a little soap were therefore substituted. One of these filled with any gas, and immersed in an atmosphere of another gas at once exposes a large surface, and by swelling and collapsing allows a free action. There are, however, three circumstances which tend to destroy such bubbles, and against these provision should be carefully made. Mechanical agitations of the surrounding air may be met, by covering the whole arrangement with a glass bell. Evaporation from the surface of the bubble, which reduces its subtance unduly, may be avoided by keeping all the gases under trial, in jars over water, until they are loaded with moisture, and thoroughly wetting the inside of the covering bell; but it is not so easy to prevent that slow motion of the parts of the bubble, which in virtue of the earth's attraction, tends gradually to bring them to the lowest part whilst the walls of it become too thin to bear the weight, and are liable to burst by the expansion of the gases accumulating within.

20. After a number of trials, the following has been found to be the most suitable arrangement for prosecuting these enquiries; it is simple, not easily deranged, and allows of sufficient latitude and change, to suit other experiments. In it a soap bubble may be preserved with certainty, for a time considerably exceeding an hour, and sometimes much longer. As here described, it was used to illustrate the relative passage of hydrogen, oxygen,and nitrogen,through a watery film into atmospheric air. It is represented in section, A A is a small tin saucer, about three inches in diameter and half an inch deep, into it water can be poured, and it also serves as a platform to support a large cupping glass *b*. Through the centre of this tin saucer at *c*, passes a glass pipe *f*, $\frac{1}{8}$ inch in diameter, the upper extremity of which is cemented into a



hole of the same size in a round, thin, piece of copper *d*, which is about half an inch in diameter, the other extremity of the pipe opening into another cupping glass *k*, through a perforation in its top, the communication being capable of being cut off, by means of a cock *g*, the lower cupping glass serves as a support to the whole arrangement when placed upon the shelf of the pneumatic trough. This apparatus is used as follows: The upper cupping glass being taken off the platform, is filled with any gas under trial, as oxygen, and placed aside on the shelf. The lower cupping glass is then filled with water, by depressing it in the trough, and the cock being closed, five hundred measures of hydrogen for instance, are thrown into it. After seeing that the copper plate *d*, is free from moisture, a drop of water rendered slightly viscid by soap is placed upon it, exactly over, where the orifice of the pipe *f* opens. The upper glass containing the oxygen, is now placed upon the little tin saucer platform, as in the figure. The lower glass is next depressed in the trough, and as soon as the cock is opened, a bubble of hydrogen containing five hundred measures expands, the spare oxygen escaping in bubbles from the upper glass, through the water in the saucer, the cock is next closed, and the apparatus placed on the trough shelf, as long as the operator desires the experiment to continue. Keeping that position when the cock is once more open, the gas passes into the lower glass, until the bubble is entirely collapsed, when the cock is again closed, the contents of the bubble being now ready for measurement, or analysis. As the gas passes from the bubble into the lower jar, the water rises from the tin saucer into the cupping glass above, confining the gas that was outside of the bubble; this, by the common mode of manipulation, is to be transferred from the tin platform to the shelf of the trough for inspection.

21. By this apparatus it was found, that one thousand measures of atmospheric air, exposed in a bubble to atmospheric air, in five successive experiments, underwent no change either in volume or composition. The duration of the trials was severally, ten, fifteen, twenty, thirty and sixty minutes, and the uniform result when drawn back into the under cupping glass was one thousand measures exactly, the composition of which was the same as atmospheric air.

22. The thermometer stood at 54° Fah. One thousand measures of hydrogen in the watery film, were subjected to atmospheric air in the upper bell; in five minutes there remained only four hundred and seventy-two. In a second trial, one thousand measures in twenty minutes, became four hundred and thirty-two; and in a third, when the same quantity of gas was confined half an hour, the residue was four hundred and eighty measures.

23. A reverse action ensues, when nitrogen is substituted for hydrogen, the bubble swells, instead of diminishing and the resulting gas measures more. It is to be remarked that after the first five minutes, provided the bubble has been sufficiently thin, there appears to be little or no change in the volume of gas, and in a great many experiments it was found, that motion had ceased when the bubble had increased somewhere between $7\frac{1}{2}$ and 10 per cent. The thermometer standing at 55° Fah. one hundred measures of nitrogen in half an hour became one hundred and seven and a half. In another trial, two hundred measures in the same time, became two hundred and fifteen. Again, two hundred in fifteen minutes, became two hundred and sixteen. The greatest variation from this was in one case, when after an exposure of five hundred measures for five minutes, the bubble was

found to contain five hundred and forty-five measures, or an increase of 9 per cent.

24. Oxygen gas exposed in like manner to atmospheric air, decreased in bulk; thus two hundred and fifty measures in ten minutes, became one hundred and fifty-three, and the like quantity in fifteen minutes, diminished to one hundred and forty-four, which amply proves that the passage of oxygen takes place through water, more rapidly than nitrogen. And upon this fundamental principle, chemical decompositions can be effected; as in the last section, where we have a bubble of nitrogen gas exposed to the atmosphere, the nitrogen outside parts with its oxygen, which, passing through the barrier, unites with the oxygen within.

25. Having thus recognised a variation in the rate of passage of gases through thin films, it becomes a point of investigation, to ascertain how long these motions will be maintained, and under what circumstances a state of equilibrium will ensue. I have already stated, that the condition of rest was simply an identity of composition of the media on both sides the membrane, a law which is rigidly observed by all gases that have yet been tried. Four hundred measures of nitrogen gas, procured by phosphorus, but which by standing over water were found to have gained $3\frac{1}{2}$ per cent. of oxygen were exposed to atmospheric air, in the apparatus above described, for thirty minutes, at the end of that time, there were found four hundred and thirty-two measures in the bubble, of which $15\frac{1}{2}$ per cent. were oxygen. Outside the bubble were ten hundred and seventy measures, which also contained $15\frac{1}{2}$ per cent. of oxygen; thermometer 57° Fah.

26. Two hundred measures of nitrogen, containing the impurity as above, were exposed for thirty minutes in an atmosphere of impure oxygen, which contained nitrogen and carbonic acid, to the amount of $13\frac{1}{2}$ per cent. At the end of that time, three hundred and sixty-one and a fourth measures were found in the bubble, of which 62 per cent. were oxygen; and eleven hundred and forty-four and a half measures were found outside, $62\frac{1}{2}$ per cent. of which were oxygen; thermometer 55° Fah.

27. Two hundred measures of oxygen were exposed to an atmosphere of hydrogen for fifteen minutes, at a temperature of 66° Fah. at the end of that time, two hundred and seven and three fourths were found in the bubble, containing $16\frac{3}{4}$ per cent. of oxygen, and twelve hundred and seventy-three outside, which also contained $16\frac{3}{4}$ per cent. of oxygen.

28. The slower passing gases being thus found to obey a very simple law of equilibrium, attempts were made to ascertain whether such, as carbonic acid, which are very absorbable by water, followed the same law; but after many trials no certain result could be obtained, so rapid was the action. Five hundred measures thus confined, passed out immediately, the bubble collapsing almost as fast as it had been expanded, a tube was therefore prepared, which had a roof of water at one extremity, about half an inch thick and two inches in diameter; beneath this roof five thousand measures of carbonic acid gas were placed, and the arrangement exposed to the atmosphere. In forty-eight hours analysis showed that a trace of carbonic acid still existed in the tube, which when washed off, about two hundred measures of unabsorbable gas remained, consisting of 20.5 oxygen, 79.5 nitrogen; and therefore, atmospheric air. This experiment would thus warrant the conclusion, that gases of any kind will pass a barrier, subject to the same regulations as those that are less absorbable, had this experiment been allowed to continue for a sufficient length of time, there can be no doubt that all the carbonic

acid gas present, would have escaped into the atmosphere, and atmospheric air alone been present on both sides of the barrier.

29. Hence the condition under which motion ceases through a barrier, is identity of chemical composition on both its sides. As gases however, pass with different degrees of velocity through the same liquid, results seemingly anomalous may be obtained, and chemical decomposition may ensue; if water recently boiled, be exposed to the atmosphere, it will be found in a few hours, to have abstracted oxygen and nitrogen gases from it, not in the same proportion, however, that exists in the circumambient air, for the gas found in water contains $\frac{1}{3}$ instead of $\frac{1}{5}$ of oxygen; perhaps in the course of time that richer gas would escape, and its place be taken by common air. We therefore consider this a case in which equilibrium has not ensued, progress only being made toward it, the decomposition and apparent anomaly being only the result of a more ready solubility and rapid passage of one gas. By taking advantage of this, it is possible to obtain from the atmosphere, oxygen of some purity. If a volume of atmospheric air be agitated with boiled water in a close vessel, it will be found that a rapid absorption of its oxygen ensues, whilst but little nitrogen is imprisoned among the pores of the liquid. This gas, by the action of fire, may be driven off from the water, and being subjected to another washing, may be rendered still more pure, by successively washing and rejecting the nitrogen left, a gas so rich in oxygen may be procured, as to be equal to some that is obtained by other processes, as by the action of sulphuric acid on peroxide of manganese. In like manner nitrogen gas of great purity may be obtained, by the action of masses of charcoal. Into five hundred measures of atmospheric air, a piece of charcoal was placed, which had been made red hot and quenched under mercury, without being allowed subsequently to come into contact with the air; in a short time the gas was found to be much reduced in volume, and ultimately there remained two hundred and five measures unabsorbed, containing only 8 per cent. of oxygen. The piece of charcoal being removed into water, gas was rapidly evolved which contained only 3.75 per cent. of oxygen, and the last portions disengaged only 2.8 per cent.

Franklin Institute.

Monthly Conversation Meeting for April.

The Eighth Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 28th of April.

Mr. George Halloway, of Miamiville, Ohio, exhibited a working model of a press for moulding bricks, together with a sample of the manufactured article, the latter very perfect in its form.

Mr. Franklin Peale explained the construction and operation of a machine for counting specie by means of which one person can arrange in uniform piles several thousand coins in a minute.

Messrs. Curtis and Hand exhibited some very neat samples of Carpenter's rules and Norfolk latches, the former manufactured by Clark & Co., of Brattleboro' Vermont, the latter by Isbell Curtis & Co. Meriden, Conn.

Messrs. H. B. Hall & Co., presented samples of improved patent Razor Strap, manufactured by E. M. Pomeroy, of Wallingford, Connecticut, which are found upon trial to be of superior quality.

Committee on Science and the Arts.

Report on Mr. Abraham Gregg's Steam Boiler.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Steam Boiler, invented by Mr. Abraham Gregg, of Warsaw, Genesee County, New York, REPORT:—

That having examined the model and specification of Mr. Gregg, they find the objects proposed by the inventor to be the exposing of large surfaces of metal to the action of the fire, compared with the quantity of water used; and the facility of getting at the interior for the purpose of cleansing the boiler.

The method by which he has proposed to effect the former object is, instead of employing a single cylindrical flue or several pipes to convey the gas through the boiler as in well known forms of steam boilers now in use, to form two concentric flues, the inner one a perfect cylinder, and the outer one having the upper portion suppressed in order to leave room for the escape of that portion of steam which may be generated between the inner and the outer flue.

It is proposed to place the fire beneath the boiler, to act on its inferior surface, that the hot air may return through the outer flue and entering the inner one, pass a third time along the length of the boiler and be discharged into the chimney.

To attain his second object, Mr. Gregg makes only the outer shell of his boiler a fixture, and all those cylinders, or partial cylinders, which constitute the concentric flues and their intermediate spaces, he makes *movable*, so as to be drawn out of each other and out of the exterior shell, somewhat after the manner of the concentric tubes in an optic glass. The spaces for water are left by means of rings, of which eight are used in the construction of this boiler, placed on the inside and riveted near the end of each exterior cylinder, which is to retain the water on the outside of the interior cylinder, which is to come next in the order. Thus each head of Mr. Gregg's boiler instead of a single solid piece of cast iron or other material, is made to consist of four concentric rings in two pairs, forming between each pair a circular joint, necessary to be rendered steam-tight, and giving two distinct water chambers only connected with each other at their upper parts where the outside concentric *flue* is interrupted for the purpose of affording a passage to the steam from the interior water chamber to the induction pipe of the engine.

The committee do not deem it necessary to enter into a detail of the manner in which it is proposed to connect the several concentric parts of this boiler together, as they are satisfied that both the objects proposed are quite as well, if not better, effected by the tubular boilers in common use than by the method above described.

They consider as wholly inadmissible, at least on a large scale, the system of loose joints in the head of a boiler, and they deem the arrangement by which the water in two separate parts of the chamber is kept from direct liquid communication to be fraught with danger whenever the water from any cause becomes low in the boiler.

The difficulty of maintaining an equable temperature throughout the system of concentric cylinders must, they apprehend, be found a most serious obstacle to the preservation of steam joints in the double rings. The delay in cleaning boilers, even when it can be done by simply entering them and

scraping out the sediment, is often of serious disadvantage; but when the joints are to be unpacked, heavy cylinders, often of many tons in weight, to be withdrawn, and after cleansing, restored to their places and the packing renewed, we cannot suppose that any difference in the cleansing will compensate for the complicated operations necessary to be performed in the present instance.

We are, on the contrary, constrained to believe that the fire surface will be less, and the trouble of cleansing greater, than in the common boiler; to which is added the danger above referred to against which they find no provision in the specification, or the model of Mr. Gregg.

By order of the committee.

February 11, 1836. WILLIAM HAMILTON, *Actuary.*

Report on Mr. William Shultz's Spark Arrester.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Spark Arrester, invented by Mr. William Shultz, of Philadelphia, REPORT:—

That they have examined the plan of Mr. Shultz for arresting the sparks from locomotive engines and that its principal features and mode of operation are as follows:

As in most other contrivances for this purpose the one now before the committee resorts to the use of the wire gauze for intercepting the sparks.

But instead of having it on the top of the chimney in the form of a bonnet or cap, it is interposed in a horizontal plane near the bottom—a conical enlargement in the chimney being provided at that place to allow a sufficiently extended surface for a free passage of the smoke and heated air.

A small door in the side just above the gauze commands a view of the whole surface of the gauze for the purpose of cleaning, &c. The advantages of this arrangement are evidently three fold. First, in admitting the escape steam to be discharged above the gauze by the pipe passing through it in the middle, thereby avoiding the serious inconvenience of the meshes becoming choked by the combined effect of soot and moisture, which is felt, when the steam is discharged below it. Secondly, in a better disposition of the weight of the apparatus which in the ordinary mode makes the chimney top heavy—and thirdly, in having all within convenient reach of the engineer. Besides the main, there are three considerable flues which are occasionally opened by slides which draw horizontally for that purpose. These flues are on different sides of the chimney passing outside of the sheet, or disk, of gauze and serve to give additional freedom to the passage of heated air and smoke, whilst the fire is starting. In an apparatus of this kind which the inventor stated had been tried on the Germantown road, the enlarged diameter of the chimney was three feet in the clear whilst that of the chimney proper was of the usual size of fifteen inches. The inventor likewise stated to the committee that the experiment was entirely successful so far as a single trial could be depended on. The committee are aware that the principle of placing the gauze below the point at which the escape steam is discharged has been before attempted by putting it in the smoke chamber. The objection to this plan seems to have been a too rapid destruction of the gauze by the heat to which it was exposed—a fate which it is feared in some degree awaits the present invention. But from the facility with which the

gauze can be replaced by removing the upper section of the chimney, the opinion is entertained that this will be found the best arrangement which has yet come to the knowledge of the committee for the accomplishment of this difficult desideratum.

By order of the committee.

March 11, 1836. WILLIAM HAMILTON, *Actuary.*

Mr. Fossard's Manufacture of Prussiates and their application to Dyeing.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. Felix Fossard's manufacture of Prussiates and their application to Dyeing, REPORT:—

That Mr. Fossard submitted to the committee an apparatus and process for the manufacture of the prussiates of potash and soda, and for dyeing with these salts.

The great improvement in the manufacture of the prussiates is in not subjecting the materials to a higher heat than that which is required to produce these salts. This is effected by a mechanical arrangement which brings every part of the material by turns in contact with the heated sides of the vessel, containing the articles from the calcination of which the prussiate results. Particular directions are given in the specification of Mr. Fossard's patent, as to the proportions of the materials, and the best mode of conducting the whole process, from the mixture of the animal matters and the potash, or soda, to the crystallization of the ferro-prussiate. The apparatus seems well adapted to its purpose. While the committee consider it unnecessary to describe the different parts, they must, in passing, observe, that the ammoniacal, or other incidental, product of the action of heat on the animal matter, are collected to be turned to account by the manufacturer.

Mr. Fossard exhibited to the committee some documents founded on the practice of his process in England, where it is also patented, and going to show considerable gain over the common method of manufacture. He also showed beautiful specimens of crystallized ferro-prussiate of potash, manufactured by this process at Stratford in England.

The committee further examined a drawing of the apparatus for dyeing blue, with the prussiate of potash and a per salt of iron, with specimens of cloths and wool dyed by the process. The dye is proposed to be substituted for indigo, particularly for dyeing coarse cloths or wool.

The cloths are dyed in the piece, and being subjected to pressure during the operation, the dye perfectly penetrates the whole thickness. Mr. Fossard has succeeded in entirely removing the harshness usually produced in the cloth by the prussiate dyeing. The varieties of shade in the specimens of cloth examined by the committee, range from light blue to black.

The committee are not prepared to say that the blue upon the fine cloths had all the richness of an indigo blue, but it is said to wear much better than the latter dye, and the seams of a cloth coat, almost thread bare, showed no whiteness. On this point the patentee submitted testimonials from respectable gentlemen known to the committee, and who had worn cloth dyed by this process. The advantage of this dye will, however, be most perceived in the coarse cloths, where the item of dyeing is a considerable one in the cost of the cloth.

The committee have particularly examined the point, whether the colour imparted to cloth in this process is entirely permanent. They have satisfied

themselves that when due care is taken in washing the cloth, there is nothing which will subsequently be removed by rubbing, or by water. They have also had the testimony of a gentleman well known to them, and who has worn a coat dyed by this process, that no exposure to weather has ever removed any part of the colour, nor has any soil appeared imparted by the cloth, when wet or dry, to the clothing with which it has been in contact. This objection then applies only to careless or defective manipulation, and is by no means a necessary consequence of the use of this dye.

By order of the committee,

May 12, 1836. WILLIAM HAMILTON, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN DECEMBER, 1835.

With Remarks and Exemplifications by the Editor.

1. For a *Hot Air and Cupola Furnace;* Leonidas V. Badger, Portsmouth, Rockingham county, New Hampshire, December 2.

This cupola furnace is to be in the usual form, and the upper part of it, above the brick lining, is to have concentric metallic cylinders, or rather truncated cones, standing four inches apart; the inner cone, at its lower end, being of the same diameter with the brick lining of the furnace body, so that the interior may be in a continuous line from top to bottom. A spiral partition is to run round within the space between the upper cones, leaving a distance of four inches between the coils, thus constituting a circuitous pipe of four inches square. Into the upper opening of this, the pipe from the bellows is to enter, and from the lower part pipes are to proceed down so as to conduct the heated air into chests, or boxes from which the tuyeres open into the furnace.

The body of the furnace, surrounding the brick lining, is likewise to be a double case, with an inch space between them.

The claim is to "the double cylinder at the top of the furnace, forming a circuitous chamber for the air, heating the blast from the flame of the furnace, thereby causing a great saving of fuel and time. Also, I claim the double cylinder to the body of the furnace, preventing the escape of heat by the confined air between the two cylinders."

Various plans analogous to the foregoing, for heating air in cupola furnaces, have been carried into operation both here and in Europe. Of some of them we have particular accounts, of others nothing more than general descriptions; and how far the patentee has been anticipated in his particular mode of effecting his purpose we are not prepared to say. The second part of his claim we think ought to have been omitted, as a double case, with air confined between, to prevent the dissipation of heat, is an arrangement familiar to every man of practical science.

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2. For an improvement in the *Composition of matter, and a Machine for Manufacturing Crayon and Pencil Points;* Guy C. Baldwin, Ticonderoga, Essex county, New York, December 2.

For this composition we are told to take equal quantities of rosin and pitch, with as much shellac as is necessary for strength, and to add to them

"finely pulverized black lead, of sufficient quantity, when melted, to form a soft paste;" then to expose the mixture to a melting heat, and to stir it with a trowel until it becomes soft and yielding. The composition is then to be put into a heated iron mould, and forced through one or more holes of any size required, when it is in a proper form for rolling, by which it acquires a polished surface. The rolls are then to be laid in a straight position, cooled, gauged, and cut into the required lengths.

The foregoing information is succeeded by a "description of the machine," which includes the trowel, the knife, the rubbing board, &c. &c. all of which, of course, are patented, as there is no discrimination between them, nor any thing which can be construed into a claim.

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3. For *Smoothing the Oxide of Iron, Brass, &c.;* Bradford Seymour, Oneida, Utica county, New York, December 2.

We are first instructed how to produce an oxide on the surface of metals, which is to be effected by heating them by any proper means. This oxide is then to be smoothed by holding the surface of the metal against a brush of wire, which may be cylindrical, or of any other suitable shape. We are in conclusion told "that this machine and art is intended to be applied to the manufacturing of an article of sheet iron, similar to the article known as Russia sheet iron."

There is no claim made, and if such a brush had been claimed the claim would have been invalid. Such "scratch brushes" have been used in the lathe for ages, and are well known to workmen; but had the thing been new, the information furnished by the patentee would have fallen far short of fulfilling the requirements of the law.

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4. For *Wheels for Rail Road Cars;* Arundius Tiers, Kensington, Philadelphia county, Pennsylvania, December 2. (See specification.)

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3. For an improvement in *Raising Sunken Vessels;* William Atkinson, and Ebenezer Hale, city of New York, December 2. (See specification.)

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6. For *Water Proof Boots and Shoes;* David Clarkson, city of New York; an alien who has declared his intention to become a citizen of the United States; December 2.

"The improvement for which I solicit letters patent, consists in having a lining to the boot or shoe composed of camel's hair, and lamb's wool, covered with gum shellac and alcohol. The lining is made over the block in the shape of the boot or shoe, then the gum shellac and alcohol are spread over with a brush, and worked in with a hot iron, after which the boot or shoe is formed over the lining in the usual manner, except that the tacks in the bottom are omitted."

It is a common practice to render hats water proof by means of shellac varnish, and the foregoing patent is for applying a similar covering to the feet, but as the patentee uses a lining of camel's hair and lamb's wool, we are at liberty to employ sheep's wool, rabbit's fur, &c. &c. without interfering with his *exclusive privilege.* For ourselves, however, we have no disposition to adopt the one or the other, as either, by confining the perspiration which ought to escape freely, would produce results not only offensive, but injurious.

7. For a *Brake for the Wheels of Cars and other Carriages;* John R. Smith, Port Clinton, Schuylkill county, Pennsylvania, December 2.

This patent is taken for a self-acting brake, and the subject is treated as though such a contrivance had not previously entered into the head of any one. So confident is the patentee of this that he says "I do not deem it necessary to describe very minutely any particular apparatus, as it must vary according to the construction of the car." It will be found, however, that the law requires such a minute description, although it does not compel the patentee to abide literally, but only substantially, by it. The claim is to "*the principle* of acting upon brakes by the contact and motion of the cars, by impeding, or stopping, the propelling power." Now the law does not grant patents for principles, but only for the means by which principles are carried into effect, yet all the information derived from the specification, on this point, is that the apparatus by which the cars are coupled is to be connected by rods, bars, or other contrivances, passing under the cars, and acting upon brakes, when brought into contact by the impeding of the locomotives, or from any other cause. We are also informed as regards common road carriages, that "any fixture on them to produce friction on the wheels, by the tendency carriages have to press forward on the horses, when descending hills, I should deem an invasion of my rights." Were such really the case, the patent law, instead of "promoting the useful arts," would become the means of putting a stop to all further improvement in the means of accomplishing any object which had been previously effected in any way.

8. For a *Machine for Drilling Rocks*; Aaron H. Vancleve, Stonington, New London county, Connecticut, December 2.

Drills are to be made to slide up and down in a frame adapted to the purpose, and are to be raised by cams upon a horizontal shaft, which is made to revolve by hand. In vol. v, p. 290, of this Journal, a similar machine is described, which was patented by J. W. and C. Post. This machine was made and tried, but was not found to answer the purpose intended; in the one now presented, there is not, any thing to insure its better action. The claim is to "the above described machine, and the arrangement and adaptation of its various parts."

9. For an improvement in the method of *Making Cast Iron Pipes:* John D. Morris, Kensington, Philadelphia county, Pennsylvania, December 2.

An iron mould is to be made in two pieces, the interior of which has the form intended to be given to the outside of the pipe, and in this respect, resembling the two sides of a flask in which a pipe has been moulded. The core is to be made and managed in the same way as when the pipe is cast in sand. Upon the lower half of the mould there is a lengthening out of one end to sustain a piece for the gate, and sinking head. It is proposed, sometimes to line the mould with a composition of fire clay and sand, provision being made, in this case, for properly forming and smoothing the surface; a groove on the edges of the mould is also to be filled with clay and sand, to cause them to fit closely together.

The claim is to "the two cast-iron pieces as above described, and also the using of a cast-iron mould to be coated over as aforesaid, within which pipes or other castings may be cast without injury to the mould, which will therefore last for a considerable length of time, and from which a great

many castings may be made, without requiring, as in the common method, an entire new mould in every instance."

10. For a *Revolving Cooking Stove;* Henry Stanley, Poultney, Rutland county, Vermont. First patented December 17, 1832. Patent surrendered, and re-issued December 2.

This cooking stove is too well known to need any description, and the decision of the United States Court which led to the surrender of the original patent was published at p. 165 of the last volume of this Journal. The following is the conclusion of the new specification.

"I do not claim the revolving of the top abstractedly, nor any one part of the above described stove, as my invention, separately, and independently of the combination herein claimed; but I do claim as my invention and improvement, the combination of the above described cap, or top plate, in connection with its revolution, and its position in relation to, and resting upon, the circular plate on which it revolves, and the rack or pinion, or other power used to cause the revolution, and the groove and flanch on which, and the centre round which, the cap or top plate turns, and the collars and flues connected as they are with the position of the plates, the fire room and diving flue, as they stand combined and connected with each other in the manner above described, and exhibited in the drawings, or in any other manner substantially the same, and as the whole combination stands connected with the other parts of said stove."

11. For *Weaving Stock Frames;* F. Goodelle and Thomas W. Harvey, Ramapo, Dutchess county, New York, December 2.

These stock frames are to be woven in a power loom, constructed for the purpose. The apparatus is necessarily complex, and does not admit of verbal description. The patent is accompanied by a very perfect engraved representation of it with numerous references. After describing the apparatus, the patentees make seven distinct claims, to those parts of the apparatus by which the loom is adapted to the special purpose to which it is to be applied. Were we to give these claims they would not afford any correct idea of the particular construction of the things claimed; upon a careful examination of them we do not find any thing which does not appear new in the manner, and for the purpose, to which it is applied.

12. For a *Machine for Hulling Clover and other Seeds;* George W. Taylor, Bridgeton, Cumberland county, New Jersey, December 4.

The rubbing is to be effected by revolving, cast-iron disks, the surfaces of which are convex, so that they are in shape like a double convex lens; the surfaces having grooves formed upon them, and which revolve between cast iron cheeks furrowed in like manner, and embrace about two-thirds of the disks, the other third being cut away to allow of the necessary space for the feeding and delivery of the seed. There is to be a feeding hopper above the revolving disks, and other necessary appendages. The claim is to the machine as described.

13. For a *Cook Stove;* Bennington Gill, city of New York, December 9.

This stove is intended principally for the purpose of cooking by means of anthracite, but the fire place may be so constructed as to burn wood, if de-

sired. The bottom plate is to be circular, to stand on feet, and to sustain a square box for the ash pit drawer. Above this is the fire place, which is made conical, its lower end being about seven inches in diameter, its upper about twelve, and its height about seven. This is surmounted by what is called the receiver, consisting of a circular plate fitting on the upper edge of the fire place, having another five inches above it, forming the two, with their rim, a flat cylinder which receives the lower parts of the cooking utensils through openings in the top plate. A plate within the receiver, over the fire, serves to distribute the heat laterally, and there are sliding valves, or dampers, to direct it under any particular vessel. The claim made is to the arrangement of the respective valves, &c. within the receivers. The difference between this stove and some which have been previously made is not very great, and so far as we can judge from the description and drawings, which are by no means defective, we should much prefer one of Stanley's rotary stoves to it, as being less complex, and more convenient.

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14. For a *Machine for Cutting Straw, and Thrashing and Winnowing Grain;* Leonard Marsh, Hartford, Windsor county, Vermont, December 9.

This is a combined machine intended, in general, to cut the straw into lengths, like an ordinary straw cutter, and to thrash the grain from it, after which the grain and straw are to be separated by winnowing, in the usual way. When the grain is to be thrashed only, the cutting knives are to be removed, the thrashing part remaining, to effect that object.

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15. For a *Gentleman's Travelling Dress Hat;* Victor De Braine, city of New York, December 9.

This is to be a kind of hat the crown of which may be flattened down, its sides folding in like the leather of a pair of bellows. A thin metallic hoop is to surround the interior of the crown at its upper, and another at its lower part, and these are to be connected together by hinges, of thin steel, having a joint in the middle, and at its attachment to each hoop. These hinges fold inwards when the crown is depressed. An intermediate hoop is also employed to increase and regulate the fold. The claim is to the particular arrangement described.

It is unfortunate for the American inventor of this hat, that precisely such hats were made and sold in Paris, at least as far back as the year 1833, at which time a friend of ours bought one in the "Place des Victoires," in that city. It is rather too late, therefore, to re-invent the thing in New York.

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16. For an improvement in the *Truss for the cure of relaxation of the Vagina, and prolapsus of the Uterus;* patented by Amos G. Hull, May 7, 1834. John F. Gray, administrator of the estate of Amos G. Hull, December 15.

The description of the improvements made by Mr. Hull in the above named truss, as given by his administrator, is not of a nature to be made known without the drawings which accompany it; we therefore pass it over.

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17. For a *Fire-place and Grate for burning wood or coal;* Charles Lane, Hingham, Plymouth county, Massachusetts, December 15.

The lower bars of this grate are to be set below the level of the hearth, and the air to feed it is to be admitted from without, through an opening regulated by a valve, or dampers. The jambs and back are to form hot air chambers, from which the heated air is to be distributed through tubes; vessels for water are also to be contained within the jambs, the vapour from which is to pass into the room through tubes. There are five distinct claims made, which we do not think it necessary to copy, as they contain little if any thing that is new; let one serve as a sample, "the generators of hot air, and the mode of transmitting it to the room." The whole description is of that general character which does not fulfil the requirements of the patent law; and were this defect cured, most of the things claimed would be found untenable.

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18. For an improvement in the *Machine for Pressing and delivering Bricks;* Ulysses Ward, Washington city, December 15.

This patent is obtained for an improvement upon the brick machine patented by Nathan Sawyer, on the 8th April, 1835, which it is proposed to simplify by dispensing with the combination of wheels for conveying the power to the press, and by certain alterations in the apparatus by which the pressed brick is delivered. These alterations, or improvements, could not be clearly described without the drawings; we are informed that the improvements, are really such, as they have been carried into operation, fairly tested and compared with the original machine.

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19. For a *Spiral Bolt, for Bolting Meal and Flour;* Aretus A. Wilder, Mount Morris, Livingston county, New York, December 15.

A spiral thread is to extend from end to end of the bolt, and from the shaft to the bolting cloth. Upon the outer edge of this thread there is a strip of tough hard wood, to which the bolting cloth is to be nailed; and at the ends the cloth is to be fastened by being received between iron hoops screwed together. The advantages of the spiral thread are set forth as though this was new, but care is taken not to include it in the claim, which is to "the frame, or reel, round which the bolting cloth is put, and the fastenings at the ends." This claim is rather obscure, as the frame or reel would include the whole, a claim which cannot be sustained. As to the "fastening at the ends," any workman, who was at a loss to devise means equally good, without interfering with the present patentee, would not be a *don* at his business.

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20. For a *Machine for cutting or splitting Laths;* Barnabus Langton, Troy, New York, December 15.

A horizontal bench, or frame, is to be made, which may be sixteen feet long and seven wide; and at each end of this there is to be a head-block, against which the laths are to be cut. The cutting is to be made from the edges of boards, sawed of a proper length, there being two cutting knives at each end of the frame. These cutting knives meet in the middle of the board, as the lath is cut, their outer ends working on pins attached to the head-block or frame, and their inner ends on similar pins connected with a sliding bar extending along the middle, and from one end of the frame to the other. The sliding bar is worked backward and forward, horizontally, by a crank motion, so that when the knives at one end are cutting a lath, those at the other are being withdrawn to allow the board to descend

for a new cut. The pieces of board are passed into a slot edgewise, at either end of the frame, and descend by their own gravity, or to a gauge which determines the thickness of the lath. It is proposed sometimes to use a single knife at each end, which knife must in that case, be the whole length of the lath.

The claim made "in the above described machine, is the machine itself, and the manner of cutting lath above specified and described."

Such a claim, we apprehend, must be understood to include not only the combination, but also the several parts as described; in which case it is much too broad, as the cutting of laths from the edges of boards, fed to the knife in a similar way, is not new. In some instances the knives used have formed a very obtuse angle in the middle, so as to cut first at the two ends, and this plan we think much preferable to the jointed knife which is at every instant altering its cutting angle. Still, should the machine before us be preferred, we think that enough of novelty might be pointed out upon which to found a valid claim.

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21. For a *Tobacco Press;* John W. Weems, West River, Anne Arundel county, Maryland, December 15.

There is not the slightest novelty in this press, although such a one may not have been used for pressing tobacco. The piston, or driver, placed horizontally, is a rack into which a pinion works, this pinion being on the shaft of a cog wheel, turned by a pinion on the shaft of a drum, or hand wheel. The hogshead into which the tobacco is to be pressed is rolled on to the frame, or ground sills of the press, one end resting against a head block, and the follower being brought up against the tobacco contained in it.

The claim is to "the before described press, for pressing tobacco and other substances."

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22. For a *Machine for Cleaning Buckwheat;* Daniel T. Laning, Bridgeton, Cumberland county, New Jersey, December 15.

A stationary hollow cylinder is to be made and fixed on a suitable frame, its periphery being in part formed of boards, and in part of woven wire. An axis passing through the centre of this cylinder carries four wings made of plank, which are caused to revolve by means of a whirl placed on the end of the shaft, thereby agitating the buckwheat which is put into the cylinder, and throwing it against the woven wire, through the meshes of which the foreign matter escapes. The claim is to "the said machine."

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23. For *Sharpening Razors, Surgical Instruments, &c.;* William Child, city of Baltimore, December 15.

Nothing can be more vague than the, so called, specification of this patent, which, we suppose, is taken for the application of some kind of hone, or slate, which the patentee has found in a quarry or bed, somewhere; even this, however, is mere conjecture, as will be seen by quoting his own words, which are, that "this discovery consists in applying adhesive or polishing slate for the purpose aforesaid, which slate or matter is composed principally of silica, of alumine, water, oxide of iron, a trace of lime, and a trace of magnesia, its specific gravity 2.6 to 2.8.

"This matter or slate may be used in any form most convenient, either as a hone, or being pulverized into a fine powder, may be placed on common razor straps, &c."

"What I claim as my invention is the application of slate or matter of the character above described, to the sharpening of the instruments and edge tools above described."

This NEW composition of matter was undoubtedly put together a few thousand, and possibly a few million of years, prior to the period when the serpent beguiled eve, and even prior to the ages in which the Saurian monsters were the lords of the land and of the ocean. "Whetstone, slate, or hone," we are told by Bakewell, "is a variety of talcy slate, containing particles of quartz; when these particles are extremely minute, and the slate has a uniform consistence and requisite degrees of hardness, it forms hones of the *best* quality." If the patentee has discovered any hones still *better*, he ought at least to have told us where he had found them, that after the expiration of his *exclusive right* to the sharpening of his razor upon a transition rock, we might enjoy the same privilege in the same degree.

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24. For *Water and other Cisterns;* Alfred Palmer, Syracuse, Onondaga county, New York, December 15.

We are informed that this patent is taken for an improvement upon that of George Tibbet's, dated December 30, 1833, (see p. 25, vol. xiv.) In the present case we shall content ourselves, and probably our readers also, by giving no more than the claim.

"What I claim as my own invention in the mode of constructing cisterns, is the taking out the tubes or curbs, and leaving the cisterns of solid cement or other hard substance, the out and insides being partially smooth and free from the inconvenience of perishable materials, and of the cleaving off of the plastering." For remarks on a similar cistern, see p. 407, last volume, and also in other places too numerous to mention.

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25. For an improvement in *Lamps;* patented October 6th, 1835. Patent surrendered to correct a clerical error, and re-issued December 16, Samuel Rust, city of New York.

The original specification was, it appears, considered by the patentee as defective, and the patent under it was issued by mistake, and contrary to his request. The form of the claim as contained in the corrected description is as follows:

"My improvement does not consist in a *stopple*, or in a *tube*, or in a *cap*, but in the application and combination of a *roller* or of *rollers*, with the said tubes, or sockets, *cap* and *stopple*, in or to the lamp as above set forth, or in any other way or manner that is essentially the same. Or inserting any *roller* or *rollers* into any *tube* or *socket* of any lamp whatever that is made to receive the wick with the said roller or rollers operating and regulating the wick of a lamp on this principle, and for which I request a patent."

We gave a brief description of the contrivance above alluded to at p. 326 of the last volume, to which we refer those who are desirous of obtaining an idea of its nature, which the above claim certainly does not convey.

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26. For a *Door Lock;* John R. and Henry C. Campbell, Charleston, Middlesex county, Massachusetts, December 28.

This is a combination lock, in which certain letters, or figures, are used to regulate the parts upon which the opening of it is dependant. There is nothing new in the principle, and the arrangement is susceptible of indefinite

changes; the modes pointed out by the patentees, are the foundation of their claim to invention, and these we do not think it necessary to particularize.

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27. For a *Steam Gauge Tube for Steam Boilers;* Samuel Raub, Jr., Wilkes Barre, Luzerne county, Pennsylvania, December 28.

This contrivance is to be called a *life saving machine*, and is intended to prevent explosions in steam boilers; the aim and the end proposed are certainly worthy of all praise, but most unfortunately we do not understand the means, or mode of operation, although nothing can be more simple than the contrivance itself, as it consists merely of a tube which is to be secured to the top, and is to reach down thence to the bottom, or nearly to the bottom, of the boiler, which tube is to have openings on its sides, extending up to a point somewhat above the surface of the water. A second tube is to slide closely down within the former, and is to extend above it; when this dips into the water, no steam, we are told, can escape; but when it is raised the steam will pass through the openings of the first, into the second tube and be discharged freely into the atmosphere. "To ensure perfect safety the second tube should always be raised according to a gauge or scale to be ascertained for each boiler." "This is claimed as an improved mode of construction different from those heretofore in use." The next improvement, we suppose, will be to boil the water in an open kettle, from which the steam might reach the atmosphere without being put to the trouble of passing through a tube.

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28. For a *Thrashing machine;* Moses Davenport, Phillips, Somerset county, Maine, December 28.

The general mode of thrashing by a cylinder and concave, is employed in this machine, the concave being placed above the cylinder. The claims made are to a feeding roller with teeth, which takes the unthrashed grain from a feeding apron, and aids in conducting it to the cylinder, and to what is called a separator, which allows the grain to pass through to riddles and fans, whilst the straw is carried off. There is nothing in this machine that requires particular notice.

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29. For a *Machine for renovating and cleaning Feathers;* Edmund Wood, Owego, Tioga county, New York, December 28.

If feathers are not cleaned and renovated, it will not be from the scarcity of machines designed to effect those purposes, the difficulty will be to choose between them, on account of their great resemblance to each other. That before us, is provided with a box, or case, to receive the feathers, having in it revolving beaters to stir them up, and beneath it a steam boiler with a tube leading into it; and in the bottom of this box there are perforations to allow dust to escape. So far, this machine is so much like some others, as to appear to be actually of the same species. There are, however, certain improvements in the dressing of the feathers not before proposed; one to disinfect them, and another to supply them with animal oil. The first is to be accomplished by putting lime and vinegar into the boiler instead of water, and supplying the feathers with the vapour therefrom. This process is rather unchemical, and appears to be put into the description for effect. To supply the feathers with animal oil, should they be deficient in this article, the cloth which is to cover the box is to be imbued with goose grease, deer foot, or other preferred oil, and the feathers as they are agita-

ted and strike against the cloth, are to absorb the requisite dose of this material, to which odoriferous articles may be added. The claims are to the apparatus, and also to the disinfecting and the oiling processes.

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30. For a *Brick Machine;* Benjamin Hamblett, Portland, Cumberland county, Maine, December 28.

The clay is to be mixed in a box by revolving arms or knives, in the manner well known, and from the lower end of this it is to pass out through an opening to be moulded and struck. The apparatus is described at great length, and there are several distinct claims; the machine so nearly resembles some of its predecessors that any attempt at description and comparison, would demand much room, and consume more time than we have to spare. The claims alone would not furnish a correct idea of the things claimed.

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31. For an *Amalgamating Mill to separate Gold from the Ores;* Joseph Curtis, city of New York, December 28.

In this mill or amalgamating apparatus, the aim is to amalgamate the gold by forcing the ore, mixed witn water, through mercury, by hydrostatic pressure. The apparatus for this purpose is clearly described and represented in the specifications and drawings. The mercury is to be contained in a cast-iron pot, at the lower part of the apparatus, and an iron tube reaching nearly to the bottom of the pot, rises vertically above it, and is lengthened out by a copper, or other, tube, so as to be about five feet in height. Through this tube, the ore, finely pulverized and mixed with water, is to be fed to the amalgamating pot, into which it passes and rises up through the mercury, by the superincumbent pressure. As it rises it has to pass over and under a number of iron shelves or partitions, which cause it to pass very circuitously before it arrives at the spout through which the earthy matter and water are to escape. To ensure the more perfect distribution of the ore, the feeding tube, with the shelves attached to it below the surface of the mercury, are made to revolve, there being a gudgeon working in a step at the lower end of the tube, and numerous small perforations to allow the ore and water to pass through.

The claim is to "the application of hydrostatic pressure to the passing of ore through a stratum of quicksilver by means of the mechanical combinations set forth in the above described mill, or by any other combination that may be preferred."

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32. For an *Amalgamating Mill to separate Gold from the Ore;* Joseph Curtis, city of New York, December 28.

The apparatus here used is the same with that described under the last patent, but with the addition of the application of heat to the iron pot containing the mercury. The claim is "to the application of heat to the ore in passing through the stratum of quicksilver, by making the fire glide around or beneath the vessel in which the process is carried forward, in the manner aforesaid or in any other manner preferred."

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33. For an *Amalgamating Mill to separate Gold from the Ore;* Joseph Curtis, city of New York, December 28.

There is but very little verbal difference between this and the last specification, both of them differing from the first in the application of heat to the amalgamating pot, and in their having an iron tube leading from the

bottom of the pot, through the fire place; which tube is to become heated to such a degree as will evaporate the mercury, and cause the gold to be deposited within the tube, a process which it is supposed, will be continued by the passing down of fresh portions of the amalgum, and the condensation of the mercurial vapour on its return to the amalgamating vessel.

The claim in this last specification is to "the application of hydrostatic pressure to the passing of ore through a stratum of quicksilver in combination with the application of heat to the ore in passing through the stratum of quicksilver in manner aforesaid, or in any other manner preferred."

We suppose that the patentee could give a good reason for taking three patents for the foregoing process, instead of including the whole in one, although we are unable to perceive it. The last two, in fact, appear to us to be for precisely the same thing.

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35. For a *Combined Cam Apparatus or Press;* Alonzo S. Greenville, Cambridgeport, Middlesex county, Massachusetts, December 30.

This apparatus, as its name indicates acts by a combination of cams, and it is intended to be used wherever heavy weights are to be raised or moved short distances, and also in such presses in which the toggle joint, or similar contrivances, are usually employed. Cams of several different sizes are placed upon the same shaft and operate like eccentrics, upon friction wheels which are likewise of different sizes; the whole to be so graduated as to adapt them to the particular purpose to which they are to be applied; describing its application to a printing press, the patentee says, "In the commencing operation of the press, the larger cam is in contact with the smaller wheel, and the descent of the platten is then, of course, the most rapid; the second and third cams then come successively into contact with their corresponding wheels, the power being thereby progressively increased in any desired proportion."

"What I claim as my invention, and wish to secure by letters patent, is the employment of the combined cam for raising weights and overcoming resistances; operating upon the principle herein set forth. I do not intend, in the construction of the same, to confine or limit myself to the precise mode by which I have exemplified my invention, but to vary the same in any way that I may find convenient, and which is in accordance with the same principle or mode of action. I also claim the particular manner of raising a platten or follower herein described."

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36. For a *Machine for Ironing;* Samuel Swett, Jr. Redfield, Kennebec county, Maine, December 30.

A cylinder, covered with flannel, or some other like substance, is to revolve at one end of the table, and upon this cylinder rests an iron plate, concave beneath, and flat at top, to receive iron heaters, the clothes to be ironed are carried, by means of a "feeder," between the roller and the heated iron which rests upon it, and when passed through the process is complete.

We do not think it necessary to lengthen out our description, as we believe that brevity will be found to correspond best with the history of this invention.

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36. For a *Thrashing Machine;* Amos Hanson, Windham, Cumberland county, Maine, December 30.

This is a machine of the most common construction, and the claim made

is to "the pulleys, bands, and wooden wheels, and the manner of operating the same thereby," a claim about as good as any that could be made where there is nothing upon which to found one.

37. For a *Mowing and Reaping Machine;* Alexander M. Wilson, Rhinebeck, Duchess county, New York, December 30.

This, like some other mowing machines, is to be driven forward by a horse, and it has on its front a horizontal revolving wheel which carries the cutters by which the mowing, &c. is to be effected. This wheel is caused to rise with the rise of the ground, by the action of small wheels or rollers, and is itself driven by means of a band around a drum on the axle of the large wheels. There are several appendages which it would be in vain to describe without the drawing. The claim is to the fly wheel with its knives or cutters, substantially as described, together with the general arrangement of the apparatus. Similar cutter wheels have been employed, and we do not see any thing in the general construction of this machine likely to insure its operating better than other mowing machines previously patented in this country and in Europe.

38. For an improvement in the *Escapement for Time Keepers;* James Fulton, Shelby county, Kentucky, December 30.

There are twenty-six figures referred to in the drawings of this improvement. The claims made, are to "the arrangement of two separate locking pallets in such a manner that they will receive the action of the teeth or pins of the scape wheel, by having springs so connected with the pallets, or with arms projecting from their axes, that by the movement of the wings or levers to which the other ends of the springs are attached, or by both, each of the pallets is alternately, in one part of the vibration, held by the pressure of the spring, in a position to come in contact with the teeth of the scape wheel, and in the other part is caused, as soon as relieved from the teeth by the other pallet, to move out of their way."

Specifications of American Patents.

Specification of a patent for an improved mode of raising sunken vessels, &c. Granted to William Atkinson *and* Ebenezer Hale, *city of New York, December 2d,* 1835.

To all whom it may concern, be it known, that we, William Atkinson and Ebenezer Hale of the city, county and state of New York, have invented a new and improved mode of raising sunken vessels, and other articles, from the bottom of rivers, seas, bays, and other waters, and which may also be employed to prevent the sinking of such vessels, or other articles, and that the following is a full and correct description thereof.

We prepare bags which are impervious to air and water, and to them we attach hose, or tubes, properly prepared, and of such length as may be necessary for the intended purpose. The most effectual way of preparing such bags and hose, is by coating canvass, or other cloth of sufficient strength, with caoutchouc, or India rubber, in a manner now well known. The form of the bags may be varied, but the best is that of a globe, as when they are distended by filling them with air, more will be contained under the same bulk than in any other form.

The bags should be properly strengthened by bands of canvass or cordage, and be sunk in the water, and firmly attached to the vessel, or other article to be raised, which may be done by means of a diving bell, or in any other way which the particular circumstances of the case may render convenient.

The hose or tubes, leading to each bag, must be of sufficient length to extend from it to the apparatus by which the bag is to be inflated, which may be on board of a moored vessel, or otherwise. The distending apparatus will consist of a common condensing or force pump, by which the air may be forced through the hose, or tube, so as to distend the bag.

It may be found convenient, and we sometimes intend, to fill the bags before sinking them, proper tackle and blocks being attached to, or passed under the vessel or other article to be raised. The inflating of the bags may in this case be rapidly effected by the use of a large, common bellows. We intend also, to use such bags, so inflated, within the hold, cabin, or other parts of vessels, which, when not wanted, will occupy but little space, and when required, may be easily inflated by a pair of bellows adapted to that purpose. In all cases, suitable air-tight valves or cocks, should be employed, and such other appendages as may be found useful for coupling the inflating apparatus, or otherwise, when securing the air within the bag.

It is not necessary for us to prescribe the size, or number of the bags to be employed: nor indeed would it be possible to do so, without assuming a particular case, but it is manifestly a thing of easy calculation, and one which must be made in every individual instance.

What we claim as our invention, and wish to secure by letters patent, is "the employment of bags rendered impervious to air and water, and furnished with hose or tubes, cock or valves, through which they can be filled with air, after being sunk and properly secured to a vessel, or any other article intended to be raised from the bottom to the surface of any water; or when first distended and afterwards sunk, as herein described. We also claim their use or employment for preventing the sinking of vessels or other articles, as set forth by us." WILLIAM ATKINSON,

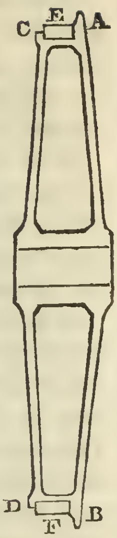
EBENEZER HALE.

Specification of a patent for an improvement in the Wheels of Rail Road Cars. Granted to ARUNDIUS TIERS, *Kensington, Philadelphia county, Pennsylvania, December 2d,* 1835.

To all to whom these presents shall come: Be it known, that I, Arundius Tiers, of the district of Kensington, in the county of Philadelphia, and state of Pennsylvania, have invented a new and useful improvement in the construction of wheels for rail road cars, and that the following is a full and exact description of the construction of said wheel as invented and improved by me. The wheel is to be made of cast iron, with a wrought iron band shrunk upon it, to form the tread of the wheel. The form and shape of the respective parts of the wheels which I most prefer, is exhibited in the drawing.

In the construction of that part of the wheel which is made of cast iron, the flanch A, B, in the accompanying section, is chilled and hardened in the mould as it is cast, in the ordinary way of chill-hardening cast iron. A small rim or flanch C, D, is formed and cast on the inner side, or face

of the wheel; this rim is intended and used to confine the wrought iron band which is afterwards to be put around the wheel. The wrought iron band E, F, is first welded together in the form of a hoop, and then heated until it has expanded sufficiently to pass over the small rim, or flanch, above referred to, when it is allowed to become cool, and to contract upon the wheel as exhibited in the drawing. This wheel possesses all the advantages of a chilled, cast iron flanch, with a wrought iron band or tread, and is therefore deemed to be decidedly preferable to the cast iron wheels with wrought iron flanches, inasmuch as the wrought iron flanches soon wear out, especially on roads that have frequent curves in them. This wheel is also exempt from one of the greatest objections to the common, chilled cast iron wheels, in being free from slits in the hub, the small quantity of metal which requires to be chilled in this wheel allows the wheel to be cast solid in the hub, and renders the precautionary operation of slitting the hub entirely unnecessary. The shape of the band is that of a flat, or oblong square, and hence it may be formed by the ordinary rolls; and consequently, when worn out may be replaced at a small expense.



What I claim as new and as my own invention or discovery, in the above described wheel, and for which I ask an exclusive privilege, is "the manner of constructing wheels with chilled flanches and wrought iron bands, as above described." ARUNDIUS TIERS.

Practical and Theoretical Mechanics and Chemistry.

Davy's Safety Lamps.

Evidence of Jonathan Pereira, Esq., F. L. S., Chemical Lecturer at the London Hospital, &c.

What is your opinion of Sir Humphrey Davy's lamp, as a security against the effects of carburetted hydrogen gas?—I do not think it is a security, because the lamp will allow the passage of the flame through it.

Will it allow the passage of the flame when suspended in the carburetted hydrogen gas, without motion? I have never seen the flame pass through the wire gauze when the lamp was at rest, and the gas not in motion. Under such circumstances the lamp may be safe, at least I have never seen it explode.

Have you seen it explode under other circumstances? Repeatedly, when the lamp, or the gas, has been in motion. I was accustomed for years to show the Davy-lamp in my lectures, and by certain experiments to demonstrate, as I then thought they did, the security of the lamp. The experiments are those usually shown in the lecture room. I am now convinced they are fallacious. There are three methods mentioned by Sir Humphrey Davy, of proving the safety of the lamp: the first method (mentioned at p. 14, 15, of his work, on the "Safety-lamp for coal-miners,") is to plunge the lamp into an explosive mixture contained in a large vessel; the second method (mentioned at p. 16 of Davy's before-mentioned work,) is to hang the lamp in a large glass receiver, through which a current of explosive gas is made to pass; the third method adopted by Sir Humphrey Davy, was tried on a "blower" in a coal

mine. He held the lamp in this blower, and though the wire-gauze soon became red hot, the flame did not pass until the gauze had reached a welding heat, and began to burn. (This is mentioned at p. 138 of his work.) Of course lecturers in London have no means of exposing it to a blower, and therefore they have usually employed, as class-room experiments, the first two mentioned methods of trying the lamp. I have never found the lamp explode by either of those methods; but, as I have already remarked they are fallacious experiments.

You think the lamp, if exposed to a current of explosive gas, decidedly unsafe? Yes, certainly. I will not say it is absolutely safe when the lamp is not moved, and where there is no current; but under such circumstances, I have never seen it explode. I may perhaps mention in what way I became convinced of the insecurity of it. Mr. Roberts has been employed by me for some years as a manufacturer, &c. of lamps; and on several occasions he told me that he was certain the Davy-lamp was not "a safety-lamp." Although I was aware that Roberts had particularly directed his attention to this subject, and from having been a working miner for many years must have been practically well acquainted with the lamp, yet as he was not accustomed to the niceties requisite in conducting chemical experiments, as I and many others had tried the lamp, and as far as I then knew, it had always been found a security against the passage of flame, I confess I thought Roberts was labouring under an error. At his urgent and repeated request, I ultimately consented to attend at Upton and Roberts' manufactory, to see him prove, if he could, the insecurity of the lamp, though fully persuaded that I should be able to find some fallacy in his experiments. In a few minutes he showed me that flame might be made to pass through a Davy-lamp; but thinking that the lamp he employed might not be perfect, I sent for one which I had repeatedly tried, and which I knew to be a perfect instrument. The flame passed through this also. Subsequently I tried the Davy-lamps of some friends, and in every case they allowed the passage of the flame. I then undertook a series of experiments, the result of which is a firm conviction of the insecurity of the Davy-lamp when in motion, or when placed in a current of explosive gas. I think we may easily comprehend why the flame does not pass when both the gas and the lamp are at rest: it depends on two circumstances, namely, the less heat developed in consequence of less gas burning; and secondly, the carbonic acid formed not being got rid of, checks the passage of the flame through the wire gauze. I think, however, that the latter is the most efficient cause, since the gauze will allow the passage of the flame when it (that is the gauze) is not hot enough to be luminous, so that a great heat is not essential. Now when a Davy-lamp is plunged into a jar of explosive mixture, a quantity of carbonic acid is immediately formed, and this mixing with the unconsumed portion of the explosive mixture, diminishes its combustibility, and therefore its explosive powers. If, on the contrary, you expose the lamp to a current of an explosive mixture, the carbonic acid which is developed is immediately got rid of, (as well as the nitrogen of the portion of atmospheric air employed in carrying on the combustion,) and then the flame passes. A gentle motion of the lamp, combined with the current of the gas, very much promotes the passage of the flame. If, for example, a lamp be held before a jet of gas until it becomes hot (a red heat is not essential), and then gently moved, the flame will pass, and the experiment may be repeated successively a number of times in a minute. Sir Humphrey Davy was well acquainted with this fact, that carbonic acid diminishes the explosive power

of gaseous mixtures. At p. 10 of his work, he says:—"On mixing one part of carbonic acid, or fixed air, with seven parts of an explosive mixture of fire-damp, or one part of azote with six parts, their powers of exploding were destroyed." At p. 32 of his book, Sir Humphrey Davy states that "the consideration of these various facts led me to adopt a form of lamp in which the flame, by being supplied with only a limited quantity of air, should produce such a quantity of azote and carbonic acid as to prevent the explosion of the fire damp, and which, by the nature of its apertures for giving admittance and exit to the air, should be rendered incapable of communicating any explosion to the external air." It is evident, therefore, he endeavored to form a lamp which should be safe from the combined influence of the carbonic acid gas, of the azote or nitrogen gas, and of the wire gauze.

State to the Committee in what way you think the lamp of Messrs. Upton and Roberts is an improvement on that of Sir Humphrey Davy?—There are several points of view under which we may regard it as an improvement. In the first place, it is quite evident that the wire-gauze of the common Davy-lamp partially obstructs or impedes the passage of flame through it; and, therefore, if you employ two layers of wire-gauze, the obstruction is greater than that produced by one. Now in practice two layers of gaze are objectionable; first, because such lamps would give very little light, and secondly, because the gauze would soon become clogged up. But even if these objections could be overcome, there exists a still more weighty one, namely, that the lamp, even with a double layer of wire-gauze, is not secure. I have repeatedly passed flame through lamps of this kind; the experiment occupies a little longer time, because the flame passes less readily through two than one; but it does pass, and therefore such a lamp is insecure. Now in Upton and Robert's lamp only one layer of wire-gauze is employed, and therefore there is little impediment to the light. To prevent the effects of lateral currents, they use a cylinder of glass placed external to the gauze. This is one improvement over the common Davy-lamp; it must be admitted, however, that Davy, at p. 136 of his work, proposed, screens to increase the security of his lamp; but neither the screens of Davy, nor the cylinder of glass employed by Upton and Roberts, would of itself be sufficient to make the lamp secure. Hence, therefore, we come to the next part of the improvement made by Upton and Roberts, and which consists in the manner they admit the external air, or the explosive mixture, to the interior of the lamp. Around the lower part of the lamp is a number of apertures, through which the air passes into a chamber, the ceiling of which consists of layers of wire-gauze. To increase the security of the lamp, any number of these layers may be employed; they are easily taken out and cleaned, and they offer no impediment to the light: whereas in Davy's lamp, any increase in the number of wire-gauzes diminishes the light. This then constitutes a most important improvement. I now pass on to another improvement in this lamp, and which in fact constitutes its superiority to all other safety-lamps that I have seen: when the air or gas has passed through the wire-gauzes, it does not pass immediately into the body of the lamp, but into a second chamber, bounded above by a conical piece of brass, having a central aperture about the size of a sixpence, in the middle of which is the wick; so that all the air passing into the lamp, is brought in contact with the wick, and thus increases the quantity of light evolved; and as the aperture is much smaller than the cavity of the wire-gauze cylinder, the latter cannot fill with flame when introduced into an explosive mixture, so that the flame can never touch the wire-gauze cylinder; and, indeed, be-

tween the flame and the cylinder there is no oxygen to support combustion, as may be shown by its extinguishing a taper; we have, therefore, the very condition Sir Humphrey Davy wanted, since no taper will burn in the space between the flame and the wire-gauze; so that you observe we have three impediments to the lateral passage of the flame, a layer of carbonic acid, a wire-gauze cylinder, and a cylinder of glass. The safety of the bottom consists in any number of wire-gauzes the maker may choose to employ, and therefore if the lamp is not safe it is his fault.

Then how is the top of the lamp secured? It is made safe by layers of wire-gauze, and also by having a contracted aperture to the glass, by which the draught is increased; and all the carbonic acid gas that is formed below, by the combustion of the fire-damp, or of the oil of the lamp, as well as the nitrogen of the atmospheric air, contribute to prevent the combustion of a body in this situation, for if you put a lighted taper here, it is extinguished immediately. Thus then this lamp is made safe at the sides, at the bottom, and at the top, by different methods. If the glass should break, the lamp is then a common Davy-lamp.

Have you made experiments on that lamp in the explosive mixture?—I have submitted this lamp to every experiment I have submitted the Davy-lamp to, and I could never get this to explode; indeed, I have submitted this lamp to a test (oxy-hydrogen gas) which it is not likely to be put to in actual practice.

This lamp then is safe in a draught or current of explosive gas?—Yes, it is perfectly safe in any current of carburetted hydrogen gas, or of this gas and oxygen, or of this gas and air. I have repeatedly tried it, and the flame will not pass. When the explosive mixture was blown in gently, the flame increased in size; if passed in with violence, the flame was extinguished, but no passage of it will take place through the gauze. Lond. Mech. Mag.

On Impact and Collision. By Eaton Hodgkinson.—Mr. Hodgkinson reported to the Section the results of certain experiments made by him on impact and collision, in continuation of those communicated to the Association in the year 1834, on the collision of imperfectly elastic bodies. The results were,

First, That cast-iron beams being impinged upon by certain heavy masses or balls of metal of different kinds, were deflected through the same distance, whatever were the metals used, provided that the weights of the masses were equal.

Secondly, That the impinging masses rebounded after the stroke through the same distances, whatever was the metal of which they were composed, provided that the weights were the same.

Thirdly, That the effect of the masses of different metals impinging upon an iron beam were entirely independent of their elasticities, and were the same as they would give if the impinging masses were inelastic.

Mr. Hodgkinson also gave the result of some interesting experiments on the fracture of wires under different states of tension, from which it appeared that the wire best resisted fracture and impact when it was under the tension of a weight which, being added to that impinging upon it equalled one third of the force that was necessary to break it.

Proceedings Brit. Assoc. &c. Lond. and Ed. Phil. Mag. Jan.

Marine Steam Engine. Extracts from the evidence given by Joshua Field, Esq., of the house of Messrs. Maudslays and Field, before the Select Committee on Steam Navigation to India.

You have had much experience in the manufacture of engines for steam vessels, have you not? Yes, I have.

What do you consider the proper measurement and power of a steamer for a long sea-voyage? The relative proportion of power and tonnage fluctuates between two tons per horse power and four tons per horse power, depending upon the purposes for which the vessel is intended, as well as the length of the voyage.

What do you say as to the measurement? By measurement, I understand tonnage. I have prepared a table which shows at one view the probable speed to be obtained by the application of engines of four different powers in vessels of the same tonnage, also the length of time for which they would be able to carry coal with each power on board. This table, if the committee desire it, I will put in.

AN APPROXIMATE TABLE,

Showing, at one view, the Tonnage of Steam Vessels with the power usually applied to such Vessels; the Number of Days of Twenty-four Hours' Coals they will carry, and the probable Speed they will go with smaller Powers and greater Quantity of Coal.

Tonnage of Vessel.	Power of Engines.	DaysCoal	Power of Engines.	DaysCoal	Power of Engines	DaysCoal	Power of Engines	DaysCoal
252	100	5	80	6¼	60	8¼	40	12
290	100	6	80	7½	60	10	40	15
332	120	7	100	8¼	80	10½	60	14
375	120	8	100	9½	80	12	60	16
425	140	9	120	10½	100	12½	80	15¾
480	140	10	120	11½	100	14	80	16½
534	160	11	140	12½	120	14½	100	17½
597	160	12	140	13½	120	16	100	19
665	200	13	160	16	140	18½	120	22½
736	200	14	160	18½	140	20	120	23½
810	220	15	200	16½	160	20½	140	24
892	220	16	200	17½	160	22	140	26
980	240	17	220	18½	200	20½	160	25½
1,073	240	18	220	19½	200	21½	160	27
	10 miles per hour.		9 miles per hour.		8 miles per hour.		7 miles per hour.	

Will you explain to the Committee the object of this calculation; is it a comparison of tonnage with the consumption of coals and days, and the rates of going? It is to show about how many days' fuel steam vessels will carry with larger and with smaller engines on board, as well as the average speed to be expected from each. Such a table can only be an approximation.

Will you first state what you consider the proper measurement and power of a steamer to go a long sea-voyage? I should recommend a vessel of from 700 to 800 tons, having an engine of 180 or 200 horse-power.

How long would such a vessel run, and at what rate would she go? She would carry coal for 14 or 15 days, and have a speed, in still water, of 9

or 10 miles per hour, and would realise in all weathers at sea, an average of 8 miles while under weigh.

What is the greatest proportion in tonnage and power for a steamer going a long voyage? The greatest proportion of tonnage for vessels going long voyages may be stated at 4 tons per horse-power. For short sea-voyages 3 tons per horse-power; and for river vessels, as Margate or Gravesend, 2 tons per horse-power.

What results does the power give to a vessel of the same tonnage with different powers as to the rate of going? Great power in small vessels gives great speed, but they carry a small quantity of coal and are soon exhausted, while larger vessels being able to carry a greater quantity of coals, work longer and perform greater distances.

Then you draw this inference—the longer the voyage the less the speed? The smaller the power the greater capacity there is left for coal, and, therefore, the greater number of days' coal it would carry.

And the less speed? And less speed, having less power.

And the smaller proportion of power would, of course, consume less fuel in an equal time? Exactly so.

Would not the greatest proportion of power consume the least fuel in equal distances? Against winds or tides it is so, but in calms and fair winds it is not.

What is the greatest distance you suppose a sea-going steamer to run without changing? The same steamer should not go more than 2,000 or 3,000 miles without a relay, or time to put the machinery in order.

Does that also include without taking in coals? A voyage of 2,000 or 3,000 miles may be performed in one stage, but it would be desirable on every account to divide it and take less coal.

What is the greatest distance she would go without coming to a station to take in fresh coals? The distance is limited only by the quantity of coal she can carry.

What is the greatest distance you think a steamer could go without taking in fresh coals? The greatest distance I have known a steamer to perform was the Enterprize, on her voyage to the Cape, in which she carried 37 days' coal.

With continued steaming, do you mean? Yes; she steamed 34 days, and had three days coal left.

Do you mean steaming day and night? Yes.

Besides the coal, is it not necessary to give the engines rest? It is; and the more frequently they can be stopped to clean and adjust, the better they will perform.

Then your observation must be supposed to apply to both? Yes.

Lond. Mech. Mag.

On the immersion of Copper for Bolts and Ship Sheathing in Muriatic Acid, as a test of its Durability. By David Mushet, Esq.—The durability of copper for bolts and ship sheathing being an object of great national importance, and as there is no better test of its resistance to waste, than immersion in muriatic acid, the following experiments, made thirteen years ago, will, it is hoped, be found not uninteresting.

Small quantities, presenting nearly equal surfaces of each of the kinds of copper described in my last communication, namely, pure shotted copper

of the quality from which brass is made, and shots obtained from unrefined copper, were separately immersed in equal weights of muriatic acid. The immersion having been continued for 48 hours, the acid was poured off, and the copper washed repeatedly, and thoroughly dried. The pure copper had lost at the rate of $5\frac{1}{2}$ grains in 100. But the unrefined copper, on being weighed, seemed to have gained half a grain; so that either a mistake must have been made in the weighing, or else a portion of unexpelled moisture had remained in the porous flakes of the copper.

Six ounces of unrefined copper were mixed with three times their bulk of charcoal, and exposed for six hours to a high heat of cementation much beyond what in the absence of the cementation would have sufficed to melt the copper. The flakes of copper were found surrounded by the charcoal, welded together without fusion, and soft and extremely flexible. Six ounces of the pure copper shots were treated in a similar manner, but the result was so far different that no adhesion of the masses had taken place, and the only perceptible change was a slight cracking or bursting upon the surface of the spheroids, which may be considered as a prelude to fusion. Both results were melted down with charcoal and run into iron moulds. The unrefined copper, when cold, was the strongest and softest; a bar of it, about $\frac{3}{8}$ths of an inch thick, cut easily across with a knife, and in colour and general appearance it very nearly resembled Swedish copper. Another piece was flattened out thin when cold for the purpose of immersion in the muriatic acid. The pure copper was melted in rather a higher degree of heat, and although not teemed until it had assumed a creamy surface, and the crucible had fallen to a low red temperature, it was crystalized throughout the whole fracture. The surface and the fracture of this copper were of a red colour; the body weak, and tearing with facility into pieces. Fragments for immersion were cut off and flattened.

The following specimens were then placed separately in muriatic acid.

No. 1, Pure copper, cut off with a chisel, . . .	53 grains
2, Ditto, flattened, ...	30 —
3, Unrefined copper, cut off with a knife . .	$39\frac{1}{2}$ —
4, Ditto, flattened, in which stuck a minute portion of the knife, . .	45 —

On the morning of the third day the following remarks were made upon their respective solutions:

No. 1, Light green colour, very transparent when dashed against the sides of the glass. No. 2, equally transparent, but the green was brownish and not so decidedly cupreous. After continuing the immersion for 48 hours longer, the acid was poured off and the specimens were well washed and dried.

No. 1, That weighed 53 grains, now weighed . .	$39\frac{1}{2}$ grains.
Loss $13\frac{1}{2}$ grains, equal to 25.4 per cent.	
No. 2, That weighed 30 grains, now weighed .	$11\frac{1}{2}$ —
Loss $18\frac{1}{2}$ grains. Equal to 61.2 per cent.	
No. 3, Unrefined copper flattened, $39\frac{1}{2}$ grains, now weighed, ...	19 grains
Loss $20\frac{1}{2}$ grains. Equal to 50 per cent.	
No. 4, Unrefined copper bar, 42 grains, now weighed,	$38\frac{1}{2}$ —
Loss $3\frac{1}{2}$ grains. Equal to 8.33 per cent.	

It would appear from this experiment that the unrefined copper resists

waste in the muriatic acid, in the same way, and to nearly the same extent, as in the cementation with lime mentioned in my last previous paper.

In corroboration of this fact, we may take the following abstract of another series of experiments, wherein the specimens were weighed three times, at intervals of 48 hours between each weighing.

Unrefined copper, 1st immersion, lost,		15	per cent.
Ditto,	2nd ditto	$8\frac{3}{10}$	—
Ditto,	3rd ditto	6	—
		$29\frac{3}{10}$	
Pure copper, 1st immersion, lost		25.4	per cent.
Ditto,	2nd ditto	9.7	—
Ditto,	3rd ditto	11.1	—
		46.2	

In favour of the unrefined copper, principally containing tin,—16.9 per cent. Two pieces of copper, the one pure, the other unrefined, were immersed, under similar circumstances, for seven days. The unrefined copper lost 17 per cent., and the pure copper 45 per cent. To ascertain whether the greater indestructibility was owing to the tin which remained in the unrefined copper, I formed a bar of alloy as follows:

Pure copper	2880	grains
Block tin	84	—

a proportion of tin about equal to 3 per cent. A piece from this bar weighing about 183 grains was exposed for seven days in muriatic acid, at the end of which time it was found to have lost 30 grains, or $16\frac{4}{10}$ per cent. The unrefined copper, above mentioned, lost in the same time and under similar circumstances, 17 per cent., which is a striking correspondence. The same piece of tin alloy, at the end of five weeks, was found to have lost in all 76 grains, or $38\frac{1}{2}$ per cent. Pure copper by the foregoing results lost in seven days' immersion 46.2 and 45 per cent.

In the first instance I was inclined to attribute the indestructibility of the unrefined copper in the acid, partly to the effects of the charcoal in the cementation, seeing that the effect produced by that operation was much greater upon unrefined than upon pure copper. Whatever advantages may belong to the proper use of charcoal in the reduction and cementation of copper (and I consider them not unimportant), the addition of a small portion of tin will be sufficient to account for the superior resistance to waste which this alloy presents in the muriatic acid, over that of the common refined copper of this country. This incapacity to rapid oxidation which is presented by the alloy of tin with copper, suggests many useful hints to the artists and the manufacturers, of which advantage has already been taken in forming ship-sheathing and other articles.

Lond. and Edin. Phil. Mag.

Progress of Physical Science.

Experimental researches in Electricity. Tenth Series. By Michael Faraday, *D. C. L. F. R. S., &c. &c.* [*From Phil. Trans.* 1835, *Part. II.*]*

The subjects embraced are, on an improved form of the Voltaic Battery,

* Received by the Franklin Institute, through the kindness of the author.

and some practical results respecting the construction and use of the battery.

Mr. Faraday has previously shown that the chemical forces in the battery are two fold, one local and producing no useful effect, the other transferred and constituting the electrical current in the instrument. By ascertaining the quantity of zinc dissolved, compared with the decomposition produced, in a volta-electrometer, the ratio of the two effects just referred to, may be determined.

In a battery of zinc plates, enclosed entirely by platinum ones, which do not touch metallically, and excited by dilute sulphuric acid, there would be no local action without transfer.

If the surrounding metal be copper, and the exciting fluid dilute nitro-sulphuric acid, a very slight discharge takes place between the adjacent coppers, especially when the circuit is completed. The theory just stated induced the construction of a battery in which a thickness of paper was used to prevent metallic contact, and thus Professor Faraday was led to the re-invention of Doct. Hare's galvanic deflagrator. To the merits of this apparatus, and of its mechanical arrangements, Prof. Faraday does full justice, as full as if it had first originated with himself, while he refers the entire credit to its author Prof. Hare.

A deflagrator of forty pairs of three inch square plates, was compared with a battery of forty pairs of four inch plates of the ordinary form with double copper plates, insulated, and proved to be its equal in igniting platinum wire, the discharge between charcoal points, the shock, &c. The power of the deflagrator diminished most rapidly, because but one seventh of the quantity of acid liquid was required to excite it, the solutions in its trough and in the cells of the other battery being of the same strength.

To compare the two batteries, the amount of zinc dissolved for each equivalent of water decomposed in the volta-electrometer, was ascertained. Three acids were tried, sulphuric, nitric and muriatic. One cubic inch of the first dissolved 486 grs. of zinc, of the second 150 grs. and of the third 108 grains.

A mixture of 200 parts, by bulk, of water, $4\frac{1}{2}$ of sulphuric acid, and 4 of nitric acid, was applied to the deflagrator before referred to, and to four troughs having plates of the size and construction before stated. One equivalent of water in the volta-electrometer, was decomposed for each 2 to $2\frac{1}{2}$ equivalents of zinc dissolved from each plate of the deflagrator, while 3.54 equivalents were required from each plate of the common battery, for the same effect.

Twenty pairs of four inch plates in a deflagrator and twenty of the same size in a common battery, gave respectively 3.7 and 5.5 equivalents of zinc from each plate for the same effect. And with ten pairs, 6.76 and 15.5 equivalents, respectively, for the deflagrator and common trough.

Prof. Faraday remarks:—

"1131. No doubt, therefore, can remain of the equality or even the great superiority of this form of voltaic battery, over the best previously in use, namely, that with double coppers, in which the cells are insulated. The insulation of the coppers may therefore be dispensed with; and it is that circumstance which principally admits of such other alterations in the construction of the trough as give it its practical advantages.

"1132. The advantages of this form of trough are very numerous and great. 1. It is exceedingly compact, for 100 pairs of plates need not occupy a trough of more than three feet in length. 2. By Dr. Hare's plan of making the trough turn upon copper pivots which rest upon copper bearings, the latter afforded *fixed* terminations, and these

I have found it very convenient to connect with two cups of mercury, fastened in the front of the stand of the instrument. These fixed terminations give the great advantage of arranging an apparatus to be used in connexion with the battery *before* the latter is put into action. 3. The trough is put into readiness for use in an instant, a single jug of dilute acid being sufficient for the charge of 100 pairs of four inch plates. 4. On making the trough pass through a quarter of a revolution, it becomes active, and the great advantage is obtained of procuring for the experiment the effect of the *first contact* of the zinc and acid, which is twice or sometimes even thrice that which the battery can produce a minute or two after. 5. When the experiment is completed, the acid can be at once poured from between the plates, so that the battery is never left to waste during an unconnected state of its extremities; the acid is not unnecessarily exhausted; the zinc is not uselessly consumed; and, besides avoiding these evils, the charge is mixed and rendered uniform, which produces a great and good result, and, upon proceeding to a second experiment, the important effect of *first contact* is again obtained. 6. The saving of zinc is very great. It is not merely that whilst in action, the zinc performs more voltaic duty, but *all* the destruction which takes place with the ordinary forms of battery between the experiments is prevented. This saving is of such extent, that I estimate the zinc in the new form of battery to be thrice as effective as that in the ordinary form. 7. The importance of this saving of metal is not merely that the value of the zinc is saved, but that the battery is much lighter and more manageable; and also that the surfaces of the zinc and copper plates may be brought much nearer to each other when the battery is constructed, and remain so until it is worn out: the latter is a very important advantage. 8. Again, as in consequence of the saving, thinner plates will perform the duty of thick ones, rolled zinc may be used; and I have found rolled zinc superior to cast zinc in action; a superiority which I incline to attribute to its greater purity. 9. Another advantage is obtained in the economy of the acid used, which is proportionate to the diminution of the zinc dissolved. 10. The acid also is more easily exhausted, and is in such small quantity that there is never any occasion to return an old charge into use. Such old acid, while out of use, often dissolves portions of copper from the black flocculi usually mingled with it, which are derived from the zinc; now any portion of copper in solution in the charge does great harm, because, by the *local* action of the acid and zinc, it tends to precipitate upon the latter, and diminish its voltaic efficacy. 11. By using a due mixture of nitric and sulphuric acid for the charge, no gas is evolved from the troughs; so that a battery of several hundred pairs of plates may, without inconvenience, be close to the experimenter. 12. If, during a series of experiments, the acid become exhausted it can be withdrawn, and re-placed by other acid with the utmost facility; and after the experiments are concluded, the great advantage of easily washing the plates is at command. And it appears to me, that in place of making, under different circumstances, mutual sacrifices of comfort, power and economy, to obtain a desired end, all are at once obtained by Dr. Hare's form of trough."*

The effects of the following circumstances are examined by Prof. Faraday under the new light thrown by his researches.

1. *Nature and Strength of Acid.* Nitric acid evolved no hydrogen, muriatic acid but little, and sulphuric acid most. They gave respectively for the equivalent of water decomposed, 1.85 eqs. of zinc for each plate, 3.8 eqs. and 4.66 eqs. by a mixture of 1 of acid to 200 parts of water. By adding to the mixture of water and sulphuric acid in proportions just referred to, 4 of nitric acid, the consumption of each zinc plate was reduced to 2.786 for each equivalent of water; 8 of nitric acid gave 2.26 eqs.; 200 water, 16 muriatic acid, and 6 nitric acid gave 2.11 eqs. per plate. This effect does not depend upon the strength of the acid solutions, the results being stated in equivalents.

2. *Uniformity in the strength of the charge*, is of great importance.

* A practical difficulty suggested by Prof. Faraday, of making a wooden trough tight under the frequent alterations of dryness and moisture, is entirely overcome by using a coating of cement in the interior as in the trough made by Dr. Hare. Cement duly applied will render unnecessary the glass sides proposed by Prof. Faraday, to prevent discharges from the edges of the plates. B

3. *Purity of the zinc* is of great importance, its impurities making the action of the battery local.

4. *Foulness of the zinc plates*, interferes materially with the action of the battery. No old charge containing copper should be used.

5. *New and Old Plates.* The former are much the most efficacious. But after a few immersions the power of rolled zinc plates becomes nearly constant. This is not the case with cast zinc plates.

6. *Vicinity of the Copper and Zinc.* When the plates are at a less distance the facility of transference is increased. The intensity and quantity of the transferred current, are both increased for a given consumption of zinc.

7. *First immersion of the Plates.* This effect, independently of the newness of the plates, is produced by the mixture of the acid in the charge with that which has been neutralized. Hare's form of trough secures this advantage.

8. *Number of Plates.* The most advantageous number depends, mainly, on the resistance to be overcome in the decomposition, but the number admits, in any given case, of a maximum.

9. *Large or Small Plates.* The use of them will depend upon the facility of the transfer of electricity. If the most advantageous number is found, additions of zinc should be made to the size. Increase of size will raise the most advantageous number.

10. *Simultaneous decompositions.* When the number of plates exceeds the most advantageous number, more than one decomposition may be made with advantage.

The conducting power of the body to be decomposed, of course, materially modifies the results obtained. The enlargement and proximity of the poles, and conducting power of the liquid, should be particularly attended to in the construction of the volta-electrometer.

Recent Researches on Heat. M. Melloni's Researches.—Though the "thermo-multiplier" of M. Melloni has now been for several years before the scientific world, it is not yet perhaps so generally known to experimenters as it deserves to be. We shall deem it, therefore, not inappropriate to the nature of this article, to state briefly its principle.

The essential part of it consists in a great number of pairs of small slips of antimony and bismuth soldered together, and combined in one case, so as to have their galvanic action excited by the application of heat. This thermo-electric effect is indicated and measured by its influence on a magnetic needle, placed below, and arranged as a galvanometer, by having many coils of wire passed round it, the wires communicating with the thermo-electric combination; the effect is increased in proportion to the number of pairs of plates. Thus the *galvanic* action on the *needle* is the measure of the amount of *heat* affecting the metallic combination; and the important and valuable part of the contrivance is, that degrees of heat, so small as to be quite insensible to the most delicate thermometers, are *multiplied*, as it were, by the multiplication of the number of pairs of metal plates, and thus produce a sensible effect on the galvanometer needle. The skill of artists has been exercised in reducing them to small dimensions. M. Gourjon of Paris, has succeeded in bringing them into so small a compass, that the end of the case which is exposed to the heat, is not greater than the section of the bulb of an ordinary thermometer.

An instrument so far surpassing all formerly known in the sensibility of its indications, has, in the hands of its distinguished inventor, led to a series of results equally new and remarkable. A brief summary of some of the chief of them is as follows:

Radiant heat passes directly, in greater or less quantity, through certain kinds of solid and liquid bodies. This class of bodies does not precisely include those which are transparent, since some which are opaque, or very little transparent, are the most "diathermanous*," that is, transparent, as it were, to *heat*. This term is one which M. Melloni has introduced as descriptive of the characteristic in question, and which we shall continue to use.

He concludes, in general, that there exist different species of heating rays; and that all these different kinds are emitted simultaneously from luminous hot bodies; though in different proportions from different sources, certain of them are entirely wanting in non-luminous hot bodies.

Rock-salt, cut into plates, and successively exposed to the radiations from different sources, transmits in all cases the same proportion of heat. Plates of any other diathermanous substance, under the same circumstances, transmit a less proportion of heat as the temperature of the source is less elevated; but the differences between one substance and another in this respect, diminish as the plate is of less thickness; whence it follows (according to M. Melloni) that the calorific rays from different sources are intercepted in a greater or less degree, not at the *surface*, or in virtue of an absorbing power which varies with the intensity, but in the *interior* of the plate, by *a peculiar absorptive force, which is analagous to that of coloured media for particular rays of light.*

M. Melloni advances several theoretical views in support of this analogy. He remarks, in general, that there is but one substance (*viz.* rock-salt) of all he has tried, which is transparent and uncoloured, and acts really in the same manner both on the rays of light and of heat. All others, though they allow all rays of light to pass indifferently, yet absorb certain rays of heat and transmit others. We thus recognise, by means of these bodies, a true distinction in heat corresponding to that of colour in light.

The colouring matter of transparent media always diminishes more or less their diathermanous properties, but gives them no peculiar property of stopping, by preference, any particular species of heating rays. It operates upon the transmission of radiant heat, as *brown* colouring matter (a smoked glass for instance) does upon light; that is, has only a general diminishing power on the intensity. There seems to be, however, an exception in regard to certain glasses coloured with green and with opaque black; but these two kinds of colouring matter only appear to act in modifying the quality of the diathermanous property.

Glass intercepts wholly certain species of heating rays, including all those which come from bodies below luminosity; hence, in this last case, no refraction by prisms or lenses has ever been effected for such rays of heat. With rock-salt, however, the case is different; and it is unquestionably the most singular and important of the facts elicited by Melloni, that simple heat is not merely transmitted through rock-salt, but absolutely *refracted* by it. He determined this both by a lens, and still more remarkably, by a prism of that substance.

With the prism interposed in the path of the rays coming from the source

* From the Greek, *δια, through;* and θερμαινω, *to feel heat.*

of heat, the effect was no longer transmitted in a straight line, but made to undergo a considerable deviation by the action of the prism. This was observed to take place in different degrees, according to the nature of the source of heat. The greatest deviation took place when the flame of a lamp was employed; the next was incandescent platinum; the next with copper, at 390° centig., and when a vessel of boiling water was substituted, the effect was found too feeble to allow of any comparison with the other cases.

However, when the rock-salt was cut in the form of a lens, the concentration of the rays, even from boiling water, was sufficient to give a decided proof of their being really brought to a focus.

Questions relating to the *transmission* of radiant heat through different media, are those which have formed the principal subject of M. Melloni's inquiries. But he has also, in one instance, directed his attention to the equally curious and important question, of the relation of the state of the *surfaces and colour* of bodies to heat. The instance referred to is an examination of the *combination* of the effect of a *screen* with that of *surfaces*, the very same, in fact, which constitutes the experiment first proposed and tried by Mr. Powell, and published in the *Phil. Trans.* for 1825. This fundamental experiment M. Melloni has repeated, and has completely verified it with his extremely accurate apparatus; a confirmation the more valuable, as some previous experimenters, since the date of the publication of the original investigation, seem to have overlooked it. It decisively proves that that portion of the heat from a flame, which passes through a glass screen, is *also* distinguished from the part which is intercepted, by the additional characteristic of affecting a *black and a white* surface in a *different ratio*. This is an inquiry eminently deserving to be followed up by the same method, and to be extended to a long series of different sorts of coating applied to the thermometer or thermo-multiplier.

Polarization of Heat. Professor Forbes.—M. Melloni failed in obtaining any detection of the effects due to the *polarization of heat*, which had been originally stated by M. Berard, though subsequent inquirers had been unable to discover any traces of it.

That zealous and highly-talented experimentalist, Professor Forbes of Edinburgh, here took up the subject. We believe we may say he was the first to introduce the use of Melloni's instrument into Great Britain. He has certainly employed it with signal success. Of such delicate inquiries as those respecting polarization, involving, in fact, complicated arrangements, which could hardly be made intelligible without lengthened details, it would not be possible to speak, in so rapid a sketch as the present, in a way to do them justice. But we must mention, however briefly and imperfectly, the valuable conclusion to which Professor Forbes's labours have led. In an elaborate and masterly paper in the *Edin. Trans.* (vol. xiii.), he has detailed these important researches. The analogies afforded by the polarization of light, led him to expect the most probable method of succeeding in the use of piles of mica; and the result fully justified his expectations.

Two piles of plates of mica were placed obliquely in the path of the rays, so that the inclination was that of the angle requisite for polarization. In such an arrangement, it is well known that in one position of the second pile all light is stopped. The same was found to be true of heat; not only from flame, but even from non-luminous sources. This was not all; as in light, the interposition of a plate of crystal between the two parts of the appara-

tus just described, *restores* or is said to *depolarize*, the light, so it was found to do with heat. On the principles of the undulatory theory this is explicable, and even subject to calculation in regard to light: by showing that a similar calculation will apply, Professor Forbes has rendered it in the highest degree probable that the same theory will hold good for heat; and has even pointed out the principle for calculating the lengths of the undulations necessary to be supposed, which he shows will be *greater* than those for light. This exactly accords with Melloni's result of their being less refrangible. Lond. Mag. Pop. Sc., April.

Keith Medal to Professor Forbes. The Council of the Royal Society of Edinburgh, have awarded this medal to Prof. Forbes, for his experiments demonstrating the polarization of light. The Vice President, in his address on the delivery of the medal, announces that Prof. Forbes has succeeded in producing the circular polarization of heat, the first public announcement of this new result. Ibid, Adress of Vice Pres. Doct. Hope, &c.

On the Prismatic Decomposition of Electrical Light. By Prof. Wheatstone. The following is a brief notice of the principle results stated in this communication: 1. The spectrum of the electro-magnetic spark taken from mercury consists of seven definite rays only, separated by dark intervals from each other; these visible rays are two orange lines close together, a bright green line, two bluish green lines near each other, a very bright purple line, and lastly, a violet line. The observations were made with a telescope furnished with a measuring apparatus; and to ensure the appearance of the spark invariably in the same place, an appropriate modification of the electro-magnet was employed. 2. The spark taken in the same manner from zinc, cadmium, tin, bismuth, and lead, in the melted state, gives similar results; but the number, position, and colours of the lines vary in each case; the appearances are so different, that, by this mode of examination, the metals may be readily distinguished from each other. A table accompanied the paper, showing the position and colour of the lines in the various metals used. The spectra of zinc and cadmium are characterized by the presence of a red line in each, which occurs in neither of the other metals. 3. When the spark of a voltaic pile is taken from the same metals still in the melted state, precisely the same appearances are presented. 4. The voltaic spark from mercury was taken successively, in the ordinary vacuum of the air-pump, in the Torricellian vacuum, in carbonic acid gas, &c., and the same results were obtained as when the experiment was performed in the air or in oxygen gas. The light, therefore, does not arise from the combustion of the metal. Professor Wheatstone also examined, by the prism, the light which accompanies the ordinary combustion of the metals in oxygen gas and by other means, and found the appearances totally dissimilar to the above. 5. Fraunhofer having found that the ordinary electric spark examined by a prism presented a spectrum crossed by numerous bright lines, Professor Wheatstone examined the phenomena in different metals, and found that these bright lines differ in number and position in every different metal employed. When the spark is taken between balls of dissimilar metals, the lines appertaining to both are simultaneously seen. 6. The peculiar phenomena observed in the voltaic spark taken between different metallic wires connected with a powerful battery were then described, and the paper concluded with a review of the various theories which have been advanced to explain the origin of electric

light. Professor Wheatstone infers from his researches, that electric light results from the volatilization and ignition (not combustion) of the ponderable matter of the conductor itself; a conclusion closely resembling that arrived at by Fusinieri from his experiments on the transportation of ponderable matter in electric discharges. Trans. Brit. Assoc. Lond. and Edin. Phil. Mag.

Kater's Portable Altitude and Azimuth Circle. An account of the performance of a small circle of this kind in the hands of the inventor, is given by Mr. Galbraith. The arch is of but three inches radius. By eight observations the latitude of Capt. Kater's house was determined within about 4.8 seconds of what was considered to be the true latitude, having been obtained by more powerful instruments. Mr. Galbraith speaks of a six inch circle of his own, with a telescope magnifying about twenty times and with three verniers to each of the circles. The level is divided to three seconds. Accounts of the satisfactory performance of his instrument are given. Jameson's Journal

Supposed discovery of a new small Planet. This discovery M. Cacciatore, director of the Observatory at Palermo, supposes he has made. He has not as yet succeeded in establishing it definitively. Ibid.

Heat conveyed by Springs. Professor Bishoff gives a number of examples in which the temperature of the interior of the earth is brought to the surface by springs, and others in which, taking their rise in cold situations, the springs bring with them to a considerable distance the low temperature of their origin. Thirteen fresh water springs near the glaciers of the Tyrolese Alps, and in the limit of their snows, had a temperature from $36\frac{1}{2}°$ to $43\frac{1}{4}°$ Fah. Some fresh water springs at the foot of the upper glacier near Grindelwald in Switzerland, had a temperature of between $37\frac{1}{2}°$ and 38°. The springs on St. Gothard 3587 feet above the level of the sea, were found by Wahlenberg and Van Buch, to have a temperature of $37\frac{1}{2}°$

On the contrary, four springs at the foot of the Great Eiger in Switzerland, had only a temperature of $42\frac{3}{4}°$. Van Buch found a spring near Neufchatel of which the temperature was only $40\frac{1}{2}°$, while the neighbouring springs were from 50° to $50\frac{1}{2}°$. Ibid.

Relative level of Caspian Sea and of the Ocean. The supposed existence of a region of dry land 18,000 square leagues in area, surrounding the Caspian Sea, and below the mean level of the ocean, has naturally excited the most lively curiosity. The fact was regarded for twenty years as established by a series of barometrical measurements made in 1811 by Professors Engelhardt and Parrot. The difference of level which these travellers assigned to the Caspian and the Black Seas amounted to about 350 feet. But Professor Parrot, having revisited the tract in 1829 and 30, soon found reason to doubt the accuracy of his former conclusions. He learnt that some Russian engineers had ascertained by careful measurements that the Don, at the place called Katschalinsk, where it is only sixty wersts distant from the Wolga, is 130 Paris feet *higher* than the latter river, and as the Don flows with much greater rapidity to the Black Sea than the Wolga does to the Caspian, the difference of level between the two seas, if any, must be considerably less than 130 feet. Parrot accordingly made a series of levellings from the mouth of the Walga to Zarytzin, 400 wersts up its course, and from the mouth of the Don to the like distance; and these observations gave as a result that the mouth of the Don was between three and four feet *lower* than that of the Wolga! So that, according to this measurement, if there is any difference between the levels of the two seas, the Caspian is the higher! Address of Pres. Lyell to Geolog. Soc. and Lond. and Edin. Philos. Mag.

Effect of Forests upon the Temperature. A motion has been lately made in the Chamber of Deputies for the general clearing of the woods in France. M. Arago showed that the clearing of extensive woods may be attended with effects of various kinds—the climate may be affected in many ways. He proceeded:—"To form a mean temperature in a given climate, there may be a very unequal distribution in the monthly temperature: it is from hence that Buffon conceived the idea of distinguishing temperate climes, from excessive ones. The climate of North America is now severe—that of Europe was equally so before it was cleared of forests. At those early periods the winters were much colder, and the summers much warmer than at present. You will perhaps be surprised to hear that a few centuries ago the summer heat in the vicinity of Paris was much greater than it is in our own times. This is a fact, however, which is proved by various documents; among others, by a charter allowing the vine-growers of Amiens to compete with other districts of France, for the honor of supplying the most perfect wines to the table of Philip Augustus. I do not suppose that any vine-growers of Amiens, at the present day, would set up the pretension of being able to supply the best wine to any one.

"A very extensive modification has occurred in the climate of that region of France—it has been the necessary consequence of clearing the woods."

Lond. Jour. of Arts, April.

Progress of Civil Engineering.

Report of E. F. Gay, Engineer on the Columbia and Philadelphia Railway, upon Motive Power.

To the Board of Canal Commissioners of Pennsylvania:

Gentlemen—Having made report to the superintendent relative to the construction of works done, or contemplated to be done, on the railway, I proceed to comply with the further instructions of your secretary, by reporting to you the situation of the line, and the motive power upon it.

The superstructure of the railway has continued in an excellent condition during the past season; indeed, with the exception of the north track, on the eastern twenty-two miles of the road; (which is constructed chiefly of wood,) the permanent character of the railway is a sufficient guarantee that few repairs of importance will be required on it for many years to come. The substructure of the road is generally of a solid and substantial character; the viaducts are the only works which are liable to injury from the heavy travel over them. Three of the piers to the Little Conestoga viaduct, and one at Mill Creek, have been badly fractured, as they were defective in their original construction; they have, however, been properly secured with buttresses, and may now be considered in a safe condition. It is probable that one other pier at Mill Creek viaduct will require the support of buttresses in the course of another summer, which work the supervisor has included in his estimate for repairs. All the other viaducts are in a good condition. As the fears of the traveling community have been frequently expressed in relation to the danger of these viaducts taking fire from the sparks emitted from the chimneys of the locomotives, it may be proper for me to remark that little fear need be entertained of fire from such a cause; this may be inferred from the fact that the cool atmosphere in the viaduct condenses the steam as it escapes from the exhaust pipes, and so

moistens the surface exposed, as to prevent ignition from the sparks; indeed, so rapidly does the steam condense during very cold weather in winter, that the water falls in drops from the interior of the bridge roof. Coals have sometimes fallen from the ash-pan of the engine on the floor of the bridge; any danger, however, from this source, is obviated by a slight coating of gravel distributed over the exposed surface. Confidence, it is believed, may therefore be justly entertained, that so great a calamity as the destruction of one of these viaducts by fire need not be apprehended from the use of locomotive engines upon the road; yet it is by all means important that a watchful eye should continually be kept over them.

The inclined planes are, and have continued during the past season, in excellent condition. I am happy to state, that in the ordinary operation of ascending and descending the plane with the aid of the machinery, not a single accident of a serious nature has occurred during the past year. The operation of the planes is, however, always attended with more or less delay, particularly in damp weather when the adhesion of the rope is diminished, and the detensions which occur are exceedingly annoying to travellers, *the fault-finding part of whom*, without stopping to inquire the cause, do not hesitate loudly to attribute it to the mismanagement of the public agents. So much has been said about the construction of railways to avoid the Schuylkill and Columbia inclined planes, that I was last summer induced to make a cursory examination, with a view to ascertain the fall and distance from a point on the railway near the Spread Eagle crossing, in Radnor township, by way of the Gulf Valley to the Schuylkill, thence along the Schuylkill to the west end of the viaduct at the foot of the inclined plane. This distance is found to be fifteen and one quarter miles, (about two miles further than by the present railway,) and the fall three hundred and eighty-one feet, being at the rate of twenty-five feet per mile. I did not, however, trace the line over the ground upon which the railway would be located, neither did my limited time allow me to take any notes with a view to estimate the cost of a railway upon that route; but, from general observation, I am of opinion that the undulating character of a large portion of the line would render the grading of a railway upon it decidedly expensive; it is, however, by no means impracticable, and is certainly worthy of a more minute examination. At the request of the citizens of Columbia, I have also made an examination, with plans, estimates, &c., of a line of railway to avoid the Columbia inclined plane; this line commences near the village of Mount Pleasant, and, passing down the valley of Strickler's run, crosses the present railway near the foot of the inclined plane, at an elevation of about twenty feet above the track, and enters Front street, in which it was designed to be continued to the basin; the whole distance of five and one quarter miles being not more than one-third of a mile longer than the present line, and the graduation will not exceed thirty-four and a half feet per mile. The grade, however, can be reduced to thirty-three and one-third feet per mile, and a superior line be obtained, by keeping to the east of Front street after crossing the railway, and passing through what has been commonly termed the alley route, which will intersect the present railway on the east side of the basin, thereby affording additional facilities for the transaction of business. The grade, although higher than desirable, yet being within the limits of locomotive power, is deemed so much superior to the present arrangement, as to justify the opinion that the charge is well worthy being recommended to the serious consideration of the legisla-

ture. The estimated cost of this change, if the rails are removed from the present line, is $110,000; or, if laid with a new wooden track, $133,360.

Motive Power.

At the date of my last annual report, two locomotive engines, viz: the Lancaster and Columbia, were in successful operation upon the line, and thirteen others had been contracted for, the most of which were expected on the road early in the spring. This anticipation, however, was not realized, as but seven engines were in readiness to meet the demands of the spring trade, since which time the number has gradually increased to seventeen, viz: ten manufactured by M.W. Baldwin, Esq.; five by Robert Stevenson of England; one by Coleman Sellers & Sons; and one by Long & Norris, the latter two have been but recently put upon the road, and their capacity is not yet fairly tested; they are, however, believed to be excellent engines. The engines from Mr. Baldwin have all been tested, and found to be of the first class. The five engines imported from England, are not so efficient as those manufactured in this country; the workmanship of them is good, but many important parts of the machines are too light to enable them to encounter (with a heavy load) the higher grades and severe curves on this railway; in consequence of which, frequent repairs are required upon them. These engines were not obtained from England, (as has been generally supposed,) with the view of getting *better* engines than could be procured in this country, but simply because locomotives could not be manufactured here, fast enough to meet the wants of the road. My own opinion has always been in favour of encouraging the mechanics of our country in the manufacture of engines. Nothing but a suitable degree of encouragement is wanting to arouse the native enterprise of our mechanics to this important branch of business; and locomotive engines brought from England to this country for sale, will most assuredly find a *bad market.*

There are not at present a sufficient number of engines on the road to meet the current demands of the trade, as in consequence of repairs required, not more than two thirds of the number on the road can be kept in readiness for actual service. This deficiency will, however, be in a great measure diminished, whenever duplicates can be obtained for such parts of the engines as are most liable to injury, and workshops can be properly arranged to do the repairs without the loss of time. Indeed, the want of suitable workshops, during the past season, to do the repairs promptly, has materially lessened the amount of available power on the road. It may be asked, "Why these workshops were not built"? To this I can only reply, that it was last year contemplated to erect additions to the shop at Columbia, so as to do all the repairs at that end of the road; but before funds were provided for the prosecution of the plans proposed, the rapidly increasing trade on the road suggested the propriety of selecting a more central position on the line for their location. It was therefore, thought most prudent to defer the matter for a month or two, that the proper point might be more clearly indicated, by the running of the engines. After due consideration of all the advantages and disadvantages, which seemed to have a bearing on the subject, it was early in July decided to erect the workshops, necessary to do all the repairs upon the road, at Parkesburg, being the point selected for the junction of the Oxford railway and the state works. This position embraces many advantages: such as being very nearly central; it is healthy, and has an excellent spring of running water for the supply of the engines. It may be proper here to remark, that a donation of

all the ground required for the accommodation of the workshops, together with a lot for a collector's office, has been made to the commonwealth, by the owner, Mr. Parke. The depot and workshops are now finished, and in readiness for the reception of the tools, and machinery, which are in a state of preparation, and will probably be completed during the present month. It is to be regretted that the want of funds has not allowed the erection of the necessary dwellings, for the workmen connected with the shops, as boarding is difficult to be obtained in the vicinity, which will of course interfere with any system that may be adopted for the repairs, until an appropriation shall be made for the necessary buildings. When this is done, and the buildings completed, a proper degree of economy can be preserved in this important branch of the establishment. The engines upon this road have generally performed their trips with great regularity; and it affords me pleasure to add, that the American engines, delivered within the present year, are capable of doing more work than was estimated in my last report: the most of them, in their ordinary trips, draw a gross load of seventy-five tons. The engine Schuylkill has drawn over the road a gross load of *one hundred tons*, and several others have drawn, over the highest grade, from eighty to ninety tons gross. When the curves and grades upon this road are taken into consideration, it is believed that the performance of these engines will be found equal to any in America. It is also gratifying for me to be able to state, that most of the prejudice which existed along the line against the use of locomotive engines last year, appears to have vanished, and in its place has arisen a prepossession in their favor: this however, is nothing more than might reasonably have been expected, for certainly no intelligent individual can witness the performance of a single engine, drawing a train of fifteen cars, loaded with three tons each, from one inclined plane to another, (seventy-seven miles,) in eight hours, without honestly acknowledging the decided superiority of steam over horses—at least so far as its application to railways.

Of the twenty locomotives authorized to be obtained for this railway, seventeen (as has been previously stated) are upon the road, and the remaining three will probably be put on during the present month.

The cost of twenty engines, complete, will be -	$126,000
Average cost of each, - - - - -	6,300

As no separate account was kept, by the collectors, of the motive power received prior to the first of January last, and as all the expenses of that branch of the establishment were paid out of the construction fund up to the 1st of February, I am not able to furnish a comparison of the receipts and expenditures for motive power, previous to the latter date. The following statement will, therefore, exhibit its income and cost for nine months, commencing February 1st, and ending November 1st.

Amount received by collectors for motive power, -	$ 46,514 98
Expenditures and debt, (see supervisor's report,) - -	45,431 75
Excess of receipts over expenses, - -	$ 1,083 23
to this is added the excess of stock on hand over last year,	4,455 30
The actual excess over cost will stand, - -	$ 5,538 53
Or, if from the expenditures, - - - - -	$ 45,431 35
Be deducted stock on hand over last year, -	4,455 30

The actual cost for motive power, for nine months, will stand,	$40,976 45
Or, average cost per day, - - - -	150 00

It is believed, that the receipts and expenditures of the ensuing year will be at least double the amount of the last year; but, as with the present tolls they would probably progress in nearly the same ratios, the preceding result will afford safe data to estimate the value of the motive power to the commonwealth. Taking, therefore, ten engines as the average number upon the road during the past season, the cost of which, at six thousand three hundred dollars each, would be sixty-three thousand dollars—

Interest of which is - - - -	$ 3,150 00
Deduct above interest from surplus receipts and stock on hand,	5,538 53
Balance left towards refunding the principal, -	$ 2,388 53

This, it is evident, will not be sufficient, as the durability of an engine will probably not exceed four, or, at furthest, five years, which would render an amount of fourteen thousand dollars per annum necessary to replace the engines, or about eleven thousand six hundred dollars more than the surplus of the present year, to each ten engines. It is believed, however, that a large portion of this amount would have been received during the past year, if all the tolls from passengers traveling on the road had been collected; but as this evidently had not been done, in order to remedy the evil, I would recommend that a careful and attentive agent of the commonwealth should be placed on each line of passenger cars, whose duty it shall be to keep a way-bill, in which he shall note the number of passengers in each car, and the distance traveled by them—and who shall also see that the conductors of each car, or train of cars, keep a like way-bill, upon which the names of all the passengers should be entered.—This plan, it is believed, would soon ensure an important increase to the revenues of the commonwealth. In order, however, to aid still further in obtaining a surplus fund for the renewal of the engines, I would suggest the propriety of increasing the toll, for motive power, on each passenger, to one cent per mile. This change would probably, in connexion with the appointment of agents to keep way-bills, ensure a sufficient revenue to meet all demands upon the road for motive power.

In the following estimate of the amount required for motive power, during the ensuing year, I have endeavored to include every expense that can be anticipated. It is still probable, however, that the rapidly increasing trade, on this great thoroughfare may require additional expenditures, which cannot, at this time, be foreseen, but which may be found absolutely necessary before, in the ordinary course of business, a second legislature could act upon them. It seems to me, therefore, highly important that some especial fund should be provided, by which (if necessary) the agents of the commonwealth could meet any extraordinary demand upon the motive power, such as the opening of other railways, which connect with the Columbia line, and which being in the progress of construction, would create.

Estimated amount required for the ensuing year.

Fifteen additional locomotive engines and tenders, at $6,400,	$96,000
One stationary engine for workshop, - - -	2,000
Tools, machinery, &c., for same, - - - - -	4,000
Additional water stations, reservoirs, &c. - - -	1,800
Turn-outs, crossings, swivels, &c. - - - -	1,500
Sheds for night stands, at water stations, - - -	2,000

Additional set of ropes at inclined planes, - - -	3,000
	$110,000
If no arrangements should be made with a view of avoiding the planes, a second set of stationary engines will be required, which, with their erection, will cost, - - -	16,000
To which should be added the covering of the planes, recommended in my last report, - - - -	25,000
Total,	$156,000

Having in previous reports expressed my opinion in relation to the manner of using this railway, I deem further remarks on that subject unnecessary. The cars being at present owned by individuals, are generally kept in good cóndition, and owners appear uniformly well disposed toward making such repairs, or alterations, as they are from time to time directed to make. * * * *

M. Brunel's mode of constructing arches without centering. The principle, which was originally adopted, and its efficacy ascertained, in the formation of the shaft of the Thames Tunnel, is founded upon the cohesive power of Roman cement, coupled with a system of ties, the most eligible substance for which, from a series of experiments performed by M. Brunel, appeared to be hoop iron. The piers having been constructed in the usual manner, it is proposed to pin, or secure, to them a mould for the purpose of determining the contour of the arch. A narrow rib may now be carried over, and keyed, using cement (with the occasional insertion of ties), which, by its adhesion to the brick being greater than the cohesion, enables the arch to be carried to any extent within the limits of the strength of the material. The several arches being in succession, once keyed, they will be in a state to receive the whole of the materials necessary to the completion of the bridge.

The bridge of the Santissima Trinitá at Florence was particularly adverted to, as affording a magnificent example of rubble construction, and the durability of the material. The arches are composed of a mass of irregular stones embedded in mortar, having the consistence of a single stone, or of two stones abutting against each other at the crown.

Lond. Archit. Mag., April.

Cast and Wrought-Iron Wheels.—It was stated at a meeting of the Institution of Civil Engineering, that where cast-iron wheels on rail-ways would only last six or eight months, wrought-iron would serve at the same work three or four years.

The wear of the Manchester and Liverpool line was stated to be 1-20th of an inch in depth per annum. The flanges rarely come into contact with the rails; one of the oldest wheels being taken off a carriage, the marks of the turning tool was found on the flange.

Lon. Mech. Mag.

Mechanics' Register.

INVENTION OF THE MARINER'S COMPASS.

The invention of this precious instrument has hitherto been awarded

to Favio Gioia, a Neapolitan, in 1302, or 1303. But this statement has rested on no satisfactory evidence; and, when it was discovered that the Chinese and Arabian authors had spoken of the magnet's polarity before the fourteenth century, it began to be suspected that the Neapolitan was merely the introducer of the compass into Europe. To settle the question, in January, 1834, Baron Humboldt wrote to M. Klaproth to ascertain the epochs,—1st. When the Chinese discovered the polarity of the magnet; and, 2d. When they began to apply it to the purposes of navigation. M. Klaproth has replied in a work, published in Paris towards the close of the year, in which the most remarkable proof of the Chinese claims to this invention, is in the history of the magnetic chariots, whose origin is lost in the obscurity of the mythological ages. The accompanying representation of one of these chariots is taken from the 33d volume of *Japanese Encyclopædia.*

The figure in front of the chariot was made of some light material; it was fixed upon a pivot, and its finger invariably pointed to the south, which, as we have already said, was the *kibleh*, or sacred point of the Chinese, to which they always turn when performing their devotions. It is intimated rather obscurely, that these magnetic chariots were first invented for a religious purpose, namely, to enable the devout to discover their *kibleh* when the sun and stars were obscured by clouds—a purpose to which the compass is frequently applied in the present day by Mohammedan nations; but there are very full descriptions of the use made of these chariots in directing the march of armies, and guiding ambassadors. M. Klaproth has collected, from Chinese authorities, many curious anecdotes of the use made of these chariots; under the Tsin dynasty they formed a part of every royal procession. In the *Tsin-tchi*, or history of that dynasty, we find—"The wooden figure placed on the magnetic car resembled a genius wearing a dress made of feathers; whatever was the position of the car, the hand of the genius always pointed to the south. When the emperor went in state, one of these cars headed the procession, and served to indicate the cardinal points."

(Magnetic Chariot.)

In the history of the second Tchoa dynasty, which lasted from A. D. 319 to A. D. 351, we read,—"The Chang-Fang (president of the board of works) ordered Kiai Fei, who was distinguished by his great skill in constructing every kind of instrument, to build a number of magnetic chariots, which were sent as presents to the principal grandees of the empire." There are several accounts of the manner in which the magnetic figures were constructed: as our readers have probably anticipated, a magnetized bar passed through the arm of the figure; and the only

variety of ingenuity displayed by the architects was in balancing the figure upon its pivot.

The antiquity of these magnetic chariots is established incontrovertibly; the step from them to the compass is so very easy, that we may safely assert that the one must have led immediately to the other.*

Arcana of Science for 1835.

The Bude Light is a name given by M. Gurney (of steam carriage abortion celebrity) to a new light which he has discovered, and so named, after his new place of residence in Cornwall. It is obtained by directing a stream of oxy-hydrogen gas on a quantity of pounded egg-shells.

Mech. Mag.

Query. In what does this differ from the well known light by a stream of wind, oxygen and hydrogen gases, on lime? The egg-shells will first be reduced from the state of a carbonate to nearly pure lime.

The Freyberg Suspension-Bridge.—We regret to learn, from a friend who has just returned from Switzerland, that, in consequence of some symptoms of insecurity exhibited by the suspension-bridge at Freyberg, the local authorities have ordered it to be stopped up for the present. Ib.

Paving with Wood.—The editor of the London Architectural Magazine, makes the following statement in relation to wooden pavements in Russia.—

The trunks of trees. from 9 in. to 1 ft. in diameter, are cut into lengths of from 12 in. to 18 in., deprived of their outside or sap wood, then squared, and afterwards set on end as common paving stones are in London. The courts of the larger mansions in Petersburg, Moscow, and Vienna are frequently paved in this manner, not for the sake of durability, nor for any reasons of economy, but simply to lessen the noise made by the wheels of carriages, when coming to set down or take up company.

Lond. Arch. Mag.

The Bell Rock Light-House has suffered greater damage during the severe gales of the last autumn and winter than at any time since its erection. The spring tides in January rose to 116 feet, and drifted over the building; while, on ordinary tides, 19 feet is the extent of their rise. The heaviest ground-swell preceded the heaviest wind by two days. Some large rocks, called "travellers," were thrown up against the foundation of the light-houses, weighing about five tons! Lond. Mech. Mag.

Drilling Holes in Glass.—A method of boring glass with a drill dipped in spirits of turpentine, has been introduced from Paris. A bow and steel drill kept moist with the spirit, rapidly drills a smooth hole through glass of any thickness; I have drilled a hole through the thick bottom of a tumbler with a broken triangular file in a very short time. The drill is not blunted more than it would be by piercing iron of the same thickness.

A. Trevelyan, in Lond. Mech. Mag.

Iron Steam Boat.—The Alburkha was built at Liverpool by Messrs. M'Gregor, Laird, & Co. Her dimensions are—"Length 70 feet; beam, 13 feet; depth, 6 feet 6 inches; tonnage, including engine-room, 56; draught of water, with engine, coals, and water in boiler, 2 feet 9 inches; with provisions, water, &c., for her voyage to the Niger, 4 feet 6 inches. The bottom and sides of this vessel are composed of iron plates, the former, five-sixteenths of an inch thick, the latter, a quarter of an inch: engine fifteen horse power. All accounts that have been received from this vessel, agree that she is much *cooler* and *drier*, and, of course, more healthy, than a vessel built of wood; that she is an excellent *sea* boat."

Nautical Magazine, vol. II. p. 678, and Arcana of Science for 1835.

List of American Patents which issued in April, 1836.

		April.
274.	*Cutting saw teeth.*—Samuel G. Merriman, Southington, Conn.	11
275.	*Furnace for smelting.*—Arundius Tiers, Kensington, Penn.	11
276.	*Boats and rafts, passing, &c.*—Benning Sanborn, Lyman, N. Hampshire,	11
277.	*Corn and cotton planter.*—George C. Boyd, New London, Penn.	11
278.	*Soda Fountains.*—R. Boston and T. Bryan, N. York,	11
279.	*Saw mill.*—Daniel Gerrish, Boston, Mass.	11
280.	*Saw mill blocks.*—Erastus Rathburn, Coneaut, Ohio,	11
281.	*Bake oven.*—Eben B. Strong, Buffaloe, N. Y.	11
282.	*Water wheels,* &c. *for mills.*—John T. Towne, Mount Morris, N. Y.	11
283.	*Serving ropes.*—Charles Parke, N. Y.	13
284.	*Sacking bottom,* &c.—L. L. Wells, Middletown, Conn.	13
285.	*Brick machine.*—Nathaniel Adams, Newburg, N. Y.	13
286.	*Hats, napping,* &c.—L. Lyon, 2nd. Needham, Mass.	13
287.	*Coffee mills.*—C. W. Peckham, New Haven, Conn.	13
288.	*Door lock.*—Benjamin Smith, Canton, Conn.	13
289.	*Cotton seed huller.*—Peirson Reading, Trenton, N. J.	13
290.	*Cotton gin.*—Peirson Reading, Trenton, N. J.	13
291.	*Mortising and boring machine.*—George Page, Keene, N. H.	13
292.	*Cooking stove.*—Charles Vale, Newark, N. J.	13
293.	*Hydrostatic press.*—Thomas Baxter, Petersburg, Va.	13
294.	*Bed, spiral spring.*—M. T. Moody, and B. Eastman, Northampton, Mass.	13
295.	*Pistols.*—Bond B. M. Darling, Billingham, Mass.	13
296.	*Spark Extinguisher.*—James F. Curtis, Boston, Mass.	13
297.	*Mortising timber.*—George Page, Keene, N. H.	21
298.	*Glass cases.*—Thomas W. Whitty, Patterson, N. J.	21
299.	*Brick machine.*—Gooding Halloway, Montgomery county, Penn.	21
300.	*Corn husks, slitting.*—Asa Bonett, Baltimore, Md.	21
301.	*Churn.*—Charles Merriman, Middletown, Conn.	21
302.	*Washing machine.*—Charles Merriman, Middletown, Conn.	21
303.	*Stove for carriages.*—Alexander McWilliams, Washington city,	21
304.	*Washing machine.*—Henry Souder, Strasburg, Penn.	21
305.	*Harrow.*—J. C. Conklin, Peekskill, N. Y.	21
306.	*Shingles, dressing.*—N. P. Hawk and J. Keyes, Union, N. Y.	21
307.	*Sawing wood.*—Jos. Pinneo, Jr. Hanover, N. H.	21
308.	*Ice cutting machine.*—Samuel Trask, Hallowell, Maine,	21
309.	*Straw cutter.*—James M. Wolfolk, Oldham co., Ken.	21
310.	*Plough.*—John Farlee, Mercer co., Ken.	21
311.	*Ores and sweepings, washing.*—William Davis, city of N. Y.	28
312.	*Paddles for boats.*—John Cochran, Baltimore, Md.	28
313.	*Bedstead fastenings.*—John McLaughlin, Sunderland, Vt.	28
314.	*Thrashing machine.*—Hugh Barclay, Lexington, Va.	28
315.	*Saw mill.*—James Sanders, Alleghany co., Md.	28
316.	*Stoves.*—Frazier H. Blanchard and B. Gill, N. Y.	28
317.	*Cotton, condensing.*—Arlon Mann, Smithfield, R. I.	28
318.	*Spring saddle.*—Peter Crim, Waynetown, Penn.	28
319.	*Cooking stove.*—Jonas Kendall, Ipswich, Mass.	28
320.	*Excavating from rivers,* &c.—Silvanus Russel, Baffalo, N. Y.	28
321.	*Smut machine.*—William B. Ryan, Mount Morris, N. Y.	28
322.	*Window blind fastenings.*—Jonathan Bacon, Bedford, Mass.	28
323.	*Carriage wheels, confining.*—Clark Force, Baltimore, Md.	28
324.	*Rail road cars.*—Isaac Knight, Baltimore, Md.	28
325.	*Lath machine.*—Elihu Smith, Ithaca, N. Y.	28
326.	*Gimblets.*—William M. Fowler, N. Branford, Conn.	28
327.	*Boxes, fitting to wheels.*—J. and C. Putnam, Hallowhill, Maine,	28
328.	*Shears for tailors,* &c.—Richard Fitzgerald, Elizabethtown, N. J.	28
329.	*Stoves.*—Frederick Frickhards, Easton, Penn.	28
330.	*Leather rolling machine.*—J. McLaughling and H. Hill, Sunderland, Vt.	28
331.	*Plough.*—Nathan Locklin, Sparta, N. Y.	28

CELESTIAL PHENOMENA, FOR AUGUST, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.				
5	13	2	v' Tauri	,5,	119°	68°
5	14	1			288	233
5	13	38	v^2 Tauri	,6,	138	85
5	14	34			270	215
22	10	2	τ Sagittarii	,4,	123	137
22	11	11			258	285

Meteorological Observations for April, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
☺	1	32°	41°	30.10	30.05	E. SW.	Moderate.		Lightly cloudy—drizzle.
	2	38	54	29.90	29.85	SW.	do.		Cloudy—clear.
	3	39	59	29.80	29.80	NW.	Breeze.		Clear day.
	4	43	43	29.73	29.13	NW. NE.	Moderate.		Cloudy—drizzle.
	5	36	52	29.76	29.84	NW.	do.		Clear day.
	6	29	36	29.95	29 95	N.	Breeze.		Cloudy day.
☽	7	27	52	30.10	30.14	WSW.	do.		Clear day.
	8	31	54	30.10	30.10	SW. S.	do.		Clear—cloudy.
	9	55	72	29.84	29.75	S. W.	Brisk.		Cloudy—lightly cloudy.
	10	55	47	29.60	29.66	S. W.	Blustering	.15	Rain—flying clouds.
	11	27	39	30.00	30.05	W.	do.		Clear—frost—flying clouds.
	12	26	50	30.30	30.34	E. SE.	Moderate.		Clear day
	13	31	42	30.20	29.90	SE.	do.	1.85	Cloudy—flurry of snow—rain.
⊗	14	41	55	29.52	29.55	W.	do.	.8	Clear—flying clouds—shower.
	15	35	49	29.75	29.75	W.	do.		Partially cloudy—flying clouds.
	16	35	55	30.03	30.11	W. SW	do.		Clear day.
	17	35	56	30.15	30.20	E.	do.		Cloudy—partially cloudy.
	18	48	61	30.00	29.86	SE. SSE.	do.	.16	Cloudy—rain.
	19	51	50	29.95	30.10	N. E.	do.	.14	Rain—rain
	20	46	62	30.15	30.24	NE.SW.	do.		Cloudy—clear.
	21	47	61	30.04	29.84	E. S.	do.	.2	Drizzle—lightly cloudy—rain.
☾	22	38	48	29.84	30 03	W.	Blustering.	.15	Clear do. brilliant aurora B.
	23	40	57	30.14	30.04	S. WS.	do.		Cloudy—flying clouds.
	24	44	57	30.10	30.20	NW. W.	Blustering.		Lightly cloudy—clear.
	25	34	61	30.40	30.36	NE. SW.	do.		Clear day.
	26	48	76	30.02	29.82	S. W.	do.		Cloudy—hazy.
	27	60	71	29.96	29.96	NW. W.	do.		Clear day.
	28	49	74	30.20	30.20	NE. S.	do.		Clear—lightly cloudy.
	29	56	71	30.10	30.00	SE. S.	do.		Cloudy—lightly cloudy.
	30	59	54	30.10	30.20	E.	do.		Cloudy—drizzle.
	Mean	40.90	55.30	29.96	29.97			2.65	

	Thermometer.	Barometer.
Maximum height during the month,	76. on 26th.	30.40 on 25th.
Minimum do. .	26. on 12th.	29.13 on 4th.
Mean do. .	48.10	29.965

JOURNAL

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State of Pennsylvania,

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DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

AUGUST, 1836.

Practical and Theoretical Mechanics.

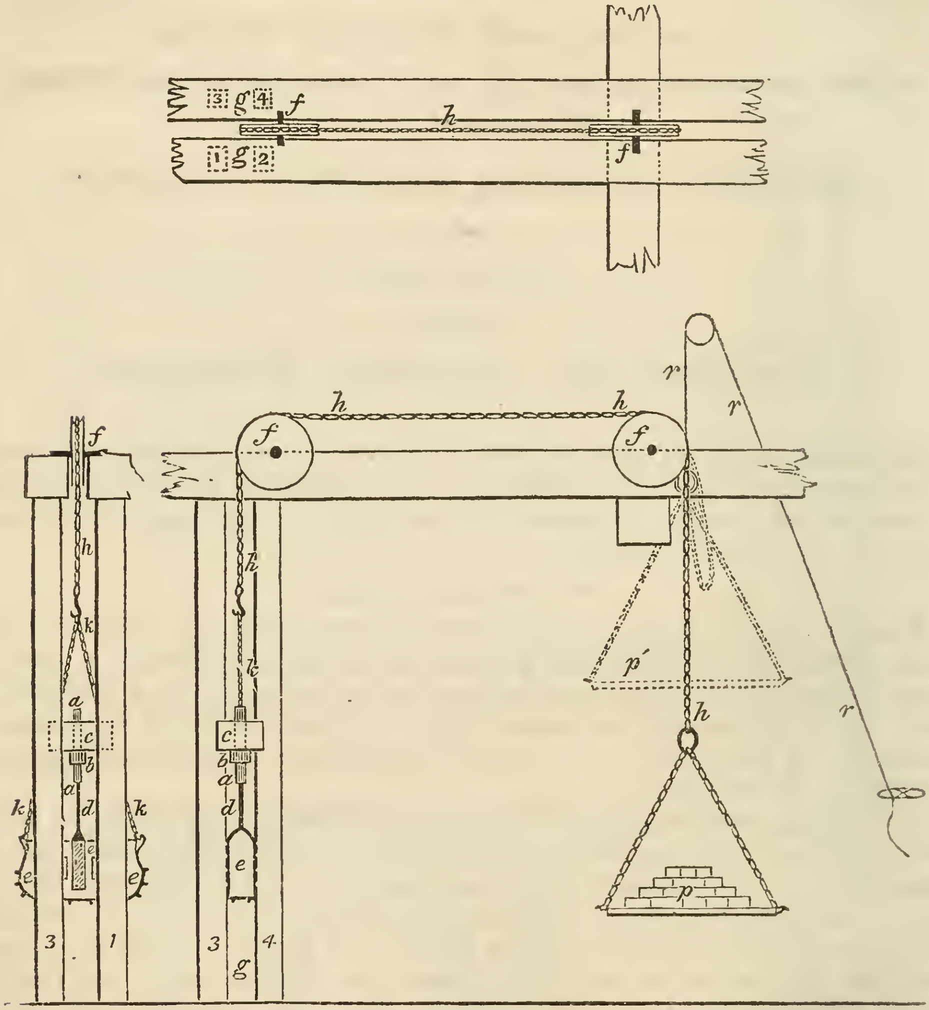
Experiments on the resistance of sand to motion through tubes, with especial reference to its use in the blasting of rocks, made at Fort Adams, Newport harbour, under the direction of Col. Totten. By Lieut. T. S. Brown, of the Corps of Engineers.

(continued from p. 8.)

For the purpose of examining further the degree and nature of the resistance offered by sand when it is attempted to force it through a tube by direct pressure, the following apparatus was arranged, after a few preliminary trials, which had given some idea of the power it would be necessary to apply. A side and end view, and a plan of the apparatus are given in the cut on the next page.

The strong cast composition tube, *a*, about fifteen inches in length, which contained the sand, was held in a vertical position by being passed through the block, *c*. The pressure was always applied to the bottom, and the collar, *b*, cast upon the tube, prevented its being forced upwards. The block *c*, was secured in its place by being let into the four posts, 1, 2, 3, 4, passing from the floor to the ceiling. These four posts formed a very stable frame work, and between each pair, the space, *g*, permitted the sliding board, *e*, to move freely up and down, and secured the proper direction to the pressing force. For the sake of distinctness this space, *g*, has been represented wider on the sketch, and the sliding board, *e*, thicker, than they actually were. The pressure was applied by means of a movable piston within the tube, connected by means of the iron rod, *d*, with the sliding board, *e*. This sliding board was attached, by means of the chains, *k*, *k*, *h*, *h*, *h*, passing over the cast iron pullies, *f*, *f*, to the platform, *p*. Of course any weight placed on this platform communicated a corresponding pressure upwards to the piston within the tube. The chain *h*, *h*, was of the best

Peru iron;* the wire was about ½ an inch in diameter, and the chain had been proved with 9 tons dead weight. The pulleys, *f, f,* were about a foot in diameter; and their axles were of wrought iron an inch and a half in diameter. When a dead weight was to be applied, the platform was loaded in the position, *p*, but if a violent shock was to be produced, the platform was held in the position, *p′*, by means of the cord, *r, r, r,* until it had received the proposed load; the cord, *r, r, r,* being then suddenly cast loose, permitted the loaded platform to fall freely by its gravity, until it had straightened the chain, when it was either entirely arrested by the resistance of the sand in the tube, or it forced its way to the floor in consequence of the yielding of the sand, or of the fracture of some part of the apparatus.



There were other minor details which it is not necessary to particularize. The fixtures were not brought to the degree of strength just stated until after many trials, and the repeated failure of nearly every part of the apparatus; and, as will be seen, a limit was soon attained, beyond which the experiments, even with this degree of strength, could not be carried. The weights used were bricks. The piston was so arranged as to move without friction when the tube was empty, and at the same time to prevent the escape of the sand when the tube was charged. Trials were made with sand poured loosely into the tube, and with sand carefully packed. The packing

* *Peru,* Clinton county, New York. The iron from this locality possesses a remarkable degree of tenacity.

was performed by means of a small sharp stick which was worked up and down in the sand as it was slowly poured in. This method was found to be the best, and is the one always used at Fort Adams, in charging drill holes for sand blasting. The sand used was dry and free from dust, and from all particles which would not pass through a hole $\frac{1}{14}$th of an inch in diameter.

A preliminary series of experiments was tried, the results of which will not be given, as they were all subsequently repeated in a more careful and accurate manner.

In the second series, a tube of tin, fifteen inches long, having an interior diameter of $1\frac{1}{4}$ inches, was used instead of the cast composition tube, *a*, above described, and a $3\frac{1}{2}$ inch bolt-rope instead of the chain, *h*, *h*, *h*. The following table indicates a portion of the results obtained.

TABLE I.

No. of the Experiment.	Number of inches of sand in the tube. — Packed.	Number of inches of sand in the tube. — Unpacked.	Weight which it was necessary to place on the platform in order to force the sand from the tube.	REMARKS.
	Inches.	Inches.	Pounds.	
36		2	310	
37	2		350	
38		3	260	
39	3		360	
40	3		760	
41		4	2166	
42	4		2540	
43	4			Experiment lost.
44	4		2150	
45	5			With 2100 lbs. the piston was not moved.
46	9			With 1900 lbs. the piston was not moved.

Observations on Table I. The tube was of the kind called double tin, 15 inches long, and $1\frac{1}{4}$ inches in diameter, folded at the seam, and strongly soldered. The piston was just inserted into the bottom of the tube, and the weights given in the fourth column, were those which were necessary to force it quite through the tube, with the sand before it. In the experiment No. 46, where 9 inches of packed sand were tried, after a weight of 1900 pounds had been placed on the platform, without producing any effect, an effort was made to drive the sand from the tube by forcing up the sliding board, *e*, with a lever. In this operation the tube was bent, and split at the soldering, but the sand was not forced out. It was soon ascertained that very great weights would have to be used when the depth of the sand was equal to, or greater than four times the diameter of the tube, and that the process would be tedious; it was accordingly resolved to abandon the use of dead weights, and employ the momentum of falling bodies. Previously to making these trials, a glass tube $\frac{3}{4}$ths. of an inch in diameter, was procured and experimented upon. It admitted six inches of sand to be forced out of it, but with 8 inches of sand well packed, it burst when a dead weight of 550 pounds was applied.

TABLE II.

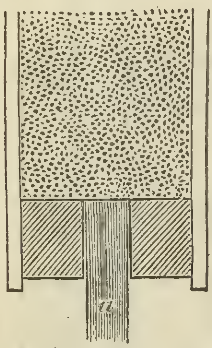
No. of the experiment.	No. of inches of sand in the tube. — Packed.	Weight with which the platform was loaded.	Distance through which the platform fell with the foregoing weight.		Distance through which the piston was forced by the foregoing power.	REMARKS.
	inches.	pounds.	feet.	inches		
47	5	920		10	none.	In these experiments the rope stretched so as to permit the platform to touch the floor before producing the full effect.
48	"	1120	2	0	do.	
49	"	1320	2	"	do.	
50	"	1320	3	"	thro' the tube	
51	6	1320	3	"	none.	Trial defective.
52	"	1630	3	"	none.	The rope was broken, trial defective
53	"	1630	3	5	thro' the tube	
54	7	1630	3	0	none.	The tube was split.
55	"	1630	3	"	$\frac{1}{4}$ of an inch.	
56	"	2030	3	"	$\frac{1}{2}$ of an inch.	The apparatus was broken, and the tube split.
57	"	1630	3	5	none.	Apparatus broken.
58	"	1630	3	4	$\frac{1}{8}$ of an inch.	
59	"	1930	2	6	$\frac{1}{4}$ of an inch.	
60	"	2030	3	0	$\frac{1}{8}$ of an inch.	Broke one of the beams supporting the pullies, *f*, *f*, and parted a $3\frac{1}{2}$ inch bolt rope.
61	"	2030	3	4	$\frac{1}{4}$ of an inch.	The rope was broken and the tube split at the soldering.
62	"	2030	4	0		Split the tube and forced out the sand in consequence.
63	"	2030	4	0	$\frac{1}{2}$ an inch	Parted a $3\frac{7}{8}$ inch white hemp rope.

Observations on Table II. The tube and rope were the same as described in observations on table I. The experiment No. 61, the top of the sand was made even with the top of the tube before the experiment was begun, by pushing up the piston until only so much space was left above it, as it was intended the sand should occupy. This rule was observed in all the subsequent experiments. This table shows that it required a weight of 1320 pounds, falling 3 feet, to force 5 inches of dry sand out of a tube $1\frac{1}{4}$ inches in diameter, and 1630 pounds, falling 3 feet 5 inches, to force out 6 inches of sand. Experiments, 60, 61, 62, and 63, showed that the apparatus in its then state could not sustain the force necessary to expel 7 inches of sand, and accordingly these experiments were suspended until a cast brass tube could be procured, and an iron chain be fitted instead of the rope. Other measures were also adopted for strengthening the apparatus. While these arrangements were making, a series of experiments were tried with a conical plug above the piston, as in the annexed sketch. The height of the cone was 3 inches, and its base equal to the area of the top of the piston. The details of these experiments it is deemed unnecessary to give. Their general result was, that within the limits tried, greater resistances were obtained when the cone was used than when it was omitted.

TABLE III.

No. of the experiment.	No. of inches of sand in the tube. Packed.	No. of inches of sand in the tube. Unpacked.	Weight with which the platform was loaded.	Space through which the loaded platform was allowed to fall.		Distance through which the piston was forced by the foregoing power.	REMARKS.
	in.	in.	lbs.	feet.	in.		
87	7		1375	3	10	$\frac{1}{8}$ of an inch	
88	7		1670	3	11	$\frac{1}{4}$ of an inch	Broke a beam over head; and on taking up the floor for the purpose of putting up new props, it was found that three of the floor joists were ruined by the severity of the previous shocks. An iron axletree, $1\frac{1}{2}$ inches in diameter, of one of the pillars, *f*, over head, was broken off.
89	7		1880	3	10	$\frac{1}{4}$ of an inch	Broke the axle of one of the pulleys over head. The beams supporting these pulleys were brought nearer together, and iron trunnion plates were placed under each axle to prevent its being forced into the wood.
90	7		2030	3		$\frac{1}{4}$ of an inch	Broke the rope *k*, *k*, connecting the chain with the sliding board, *e*, under the piston. A chain was substituted in the place of this rope, and the apparatus thus made to conform in all respects, with the description which has been given of it.
91	7		2030	3	6	$\frac{1}{2}$ of an inch	
92	7		2286	3	11	Piston forced thro' the tube.	In this and all other cases where the piston was forced through the tube, a quantity of fine dust, apparently arising from the pulverization of a part of the sand, collected on the sides of the tube and at the top of the piston.
93	8		2286	3	9	$\frac{1}{4}$ of an inch	
94	"		2490	3		$\frac{1}{4}$ of an inch	Broke a large iron hook at the tube end of the large chain.
95	"		2490	3		1-16 "	Broke the large chain in four places.
96	"		2490	3	9	$\frac{1}{4}$ of an inch	
97	"		2644	3		$\frac{7}{8}$ of an inch	Broke one of the hooks connecting the chain, *k*, *k*, with the sliding piece, *e*.
98	"		2644	3		none	Broke the large chain. The apparatus could not, without considerable trouble and expense, be made to sustain the force necessary to expel 8 inches of packed sand, and the further pursuit of this inquiry was therefore abandoned.
104		7	361	3	8	Piston forced thro	
105		8	361	3	3	$2\frac{5}{8}$ inches.	
106		9	615	3	10	Pn. forced through	
107		10	615	3	9	none	
108		10	870	3	10	Pn. forced through	
109		11	870	3	8	$\frac{5}{8}$ of an inch	
110		11	1122	3	3	1 inch.	
111		11	1375	3	4	2 inches.	The interior diameter of the tube was now increased to 1 7-16 in inches, with which all the remaining experiments were made.
113		11	1630	3	10	Pn. forced through.	
115		12	1880	3	3	$\frac{7}{8}$ of an inch	Broke the chain.
118		12	2136	2	3	$\frac{1}{2}$ of an inch	Broke the chain.
120		12	2136	3	3	$\frac{1}{2}$ of an inch	Broke the chain. This chain being much strained & worn by previous shocks a new one was procured.
121		12	2136	3		$\frac{3}{4}$ of an inch	Broke the chain.
122		12	2136	3	6	Pn. forced through	
124		13	2136	3	9	$1\frac{3}{4}$ inches.	

Observations on Table III. The tube was of brass, cast about one-fourth of an inch thick, the interior diameter being one and one-fourth inches as far as experiment No. 111, after which it was increased to one and seven-sixteenth inches. A chain, capable of supporting nine tons, was substituted for the rope, *h*, *h*, *h*., and after experiment No. 90, a strong chain was employed in lieu of the rope, *k*, *k*. The apparatus was strengthened in a variety of ways to enable it to resist the great shocks it was subjected to. It appears from this table, that to expel seven inches of dry packed sand from a tube one and one-fourth inches in diameter, it was necessary to employ a weight of 2286 pounds falling through a space of three feet eleven inches. A weight of 2644 pounds falling three feet, was insufficient to force from the same tube eight inches of sand. Sand poured loosely into the tube, without being packed, offered much less resistance. Seven inches of loose sand was expelled by a weight of 361 pounds falling three feet eight inches; nine inches by a weight of 615 pounds, falling three feet nine inches; and ten inches by a weight of 870 pounds falling three feet ten inches. Eleven inches in a tube of one and seven-sixteenth inches bore, was expelled by 1630 pounds, falling three feet ten inches; twelve inches, by 2136 pounds, falling three feet six inches; and 2136 pounds, falling three feet nine inches, did not drive out thirteen inches of loose sand. The strength of the apparatus did not admit of carrying these trials further in this way, and it was resolved to use gun-powder; but in the meantime to determine the resistance which would be offered by the sand to the entrance of iron rods of much less diameter than the bore of the tube, the following experiments were made. Rods of one-fourth, one-half, and three-fourths of an inch diameter were used. The tube being one and seven-sixteenths inches in diameter, a wooden piston having a hole in its centre, just large enough to admit the rod *a*, in the manner indicated by the annexed sketch, was placed in it, and the rod being entered into the piston, the sand was placed above it as usual. With this apparatus, the experiments contained in table IV. were, among others, tried.



Observations on Table IV. The resistance opposed by the sand to the entrance of a rod of smaller diameter than the tube, was very great, and increased with the size of the rod. A weight of 2033 pounds was required to force a $\frac{1}{4}$ inch rod through 8 inches of sand. With 12 inches of sand, a weight of 3150 pounds was required to force the same rod, sharpened, $2\frac{1}{2}$ inches into the tube. Sharpening the $\frac{1}{4}$ inch rod, seemed rather to increase than to diminish the resistance. A half inch rod was forced through 8 inches of sand, by 870 pounds falling 4 feet. With 13 inches of sand, a $\frac{1}{2}$ inch rod was forced only $1\frac{3}{4}$ inches, by a weight of 1880 pounds falling 3 feet 6 inches. A rod $\frac{3}{4}$ of an inch in diameter, was forced through 8 inches of sand by 1120 pounds, falling 3 feet 10 inches; and the same rod was forced through 13 inches of sand by 2136 pounds, falling 3 feet 3 inches. In all cases the sand immediately before and around the rods, was crushed to a fine powder.

Trials with Gun Powder.

166. A musket barrel, of three-fourths of an inch bore, was charged with two inches of powder and thirteen inches of packed sand, there being

neither wad nor plug between the sand and the powder. On firing, the barrel was burst, but the sand was not driven out.

TABLE IV.

No. of the experiment.	No. of inches of sand. Packed.	Dead weight applied.	Falling weight.	Distance through which the loaded platform was allowed to fall.		Distance which the iron rod was forced into the sand, by the foregoing power.	REMARKS.
	in.	lbs.	lbs.	feet.	in.	inches.	
Iron rod ¼ of an inch in diameter.							
133	8	615				¼ of an inch.	
134	"	1150				1 inch.	
135	"	1630				1½ "	
136	"	2033				thro' the sand.	
137	12	615				3-16 of an in.	
138	"	1150				½ "	
139	"	1630				1 inch.	
140	"	2136				1½ inches.	
141	"	2480				?	Rod bent and broken.
142	"	615				3-16 of an in.	In these trials the end of the rod was sharpened.
144	"	1630				7-8ths. "	
146	"	2390				1¾ inches.	
148	"	3000				2¼ "	
149	"	3150				2½ "	
150	8		360	3	4	2 "	
151	"		615	3	4	thro' the sand.	
Rod ½ an inch in diameter.							
152	8		360	3	6	1½ inches.	
153	"		490	4		1¾ inches.	
154	"		615	4		1¾ inches.	In this and every other instance a mass of finely pulverized sand was found at the head of the rod.
155	"		870	4		thro' the sand	The sand around the rod was pulverized to a fine powder.
157	13		1120	3	3	1 7-8 inches.	The rod was bent below the tube.
158	"		1375	3	3	½ an inch.	
159	"		1880	3	6	1¾ inches.	Bent the rod double in two places below the tube.
Rod ¾ of an inch in diameter.							
160	8		870	3	10	¾ of an inch.	
161	"		1120	3	10	thro' the tube	The sand around the rod crushed to a fine powder.
162	13		1120	3	9	7-8 of an inch.	The pulverized sand at the head of the rod as usual.
163	"		1375	3	6	1 inch.	The chain was broken.
164	"		1880	3	6	1¼ inches.	
165	"		2136	3	3	thro' thesand	

167 & 168. A brass blunderbuss barrel of three-fourths of an inch bore, was charged with one inch of powder and ten inches of packed sand, a

wooden plug being placed between the powder and sand. On firing, the plug was split, and all the sand driven out, but the pieces of the plug remained in the barrel, which was apparently uninjured. The same barrel burst with one inch of powder and ten inches of packed sand, with a conical wooden plug between the sand and the powder.

169. A pistol barrel of nine-sixteenths of an inch bore, burst with one inch of powder and eight inches of packed sand, without wad or plug.

170. An old musket barrel of three-fourths of an inch bore, was loaded with three-fourths of an inch of powder and five inches of packed sand, without wad or plug. On firing, the barrel was burst, but the sand was not driven out.

172. A piece of musket barrel, taken from near the muzzle, and open at both ends, was charged at one end, with five and a half inches of brick dust, hard rammed, and at the other, with five and a half inches of sand, well packed, with one inch of powder between them, a priming hole being bored to communicate the fire. The explosion of the powder burst the barrel, but neither the sand nor the brick dust was driven out.

177 to 184. A pistol barrel made of twisted iron, and of great strength, the bore being eleven-sixteenths of an inch, was fired with three-fourths of an inch of powder, and the following loads of sand, each one, with, and without, a wad, viz: three inches, four inches, five inches, and six inches. In all these trials the sand was driven out without causing the barrel to burst.

185. The same pistol barrel was loaded with one inch of powder, and eight and one-fourth inches of sand, with a conical plug between the sand and the powder. On firing, the sand was forced out.

186. The same barrel was charged with one inch of powder and eight and one-fourth inches of sand, without wad or plug. On firing, the sand was driven out, and the barrel was burst.

In order, if possible, to determine a limit to the resistance opposed by sand, it was resolved to make use of a twenty-four pound cannon. It was thought not improbable, that by the use of clean dry sand, which is generally obtained in the vicinity of the sea coast batteries, a ready method would be discovered of effectually destroying heavy guns, an object which is occasionally of great importance. Application was therefore made to the ordnance department for permission to experiment with an old pattern twenty-four pounder, laying at Fort Adams, which permission was very liberally and readily granted. The length of the bore of this piece was about nine feet, and the diameter of the bore $5\frac{82}{100}$ inches. It was first fired in a horizontal position, with eight pounds of powder and one foot of sand, afterwards with the same quantity of powder and two feet of sand, again with the same quantity of powder and three feet of sand, and so on, the depth of the sand constantly increasing by one foot, until the bore was full. The gun was then placed in a vertical position, and loaded with the same quantity of powder, and filled up to the muzzle with sand, well packed, without wad or plug. It was afterwards charged in a similar manner, a cone of wood being interposed between the powder and the sand. In these two cases the fire was communicated to the charge by means of a priming tube, passing down through the sand from the muzzle of the gun. Afterwards the gun was charged in the same manner, and fired by means of the vent. A better quality of powder was then used, and the quantity was increased to sixteen pounds. The gun was several times fired with this charge, the bore being filled up to the muzzle with sand well packed. In every in-

stance the sand was forced out without apparent injury to the gun. It appeared, therefore, that the resistance of the sand, though very great, was not sufficient to burst a twenty-four pound cannon.

The most probable explanation of the foregoing phenomena, appears to be, that whenever direct pressure is applied, the angular and irregular shaped fragments composing the sand, immediately form themselves into a natural arch, supported against the sides of the tube. The annexed sketch indicates the manner in which this may take place. In every instance where the sand was violently forced from the tube, the sides of it were found to be lined with a quantity of fine dust, and a mass of pulverized sand was generally found at the head of the piston A. The inside of the tube was abraded or scratched, particularly at that part, a short distance above the piston, against which the *arch*, or more strictly, the *inverted dome* of sand, may be supposed to have abutted. The dust found on the sides of the tube was always of a blueish colour, which was attributed to the intermixture of a small portion of metallic oxide derived from the brass. Some experiments which were made went to show that it was very important that the sand should be perfectly dry. The injurious effect of moisture may be explained by supposing that it impedes the free motion of the particles among themselves, and prevents their promptly assuming the arch form; it cements the sand into a mass, which is expelled from the tube as a solid body would be. In the case of the twenty-four pounder, it appears that the force necessary to burst the gun, was greater than that required to reduce sand to an impalpable powder, that is, to crush and destroy the materials of which the arch of sand was composed. It is probable that coarse emery, from its extreme hardness, would oppose a resistance sufficient to burst a cannon, but an opportunity has not offered to make the trial.

The experience at Fort Adams, proves that the resistance offered by sand is quite sufficient for blasting rocks, and the advantages attending its use, are, that it is much less troublesome than the usual mode, and that it is perfectly safe. To ensure success, the space left above the powder should have a length of ten or twelve times as great as the diameter of the hole. To communicate fire to the powder, a slip of paper is rolled into a tube about three-sixteenths of an inch in diameter. This priming tube is secured by being tied round in two places with thread, and one end is made a little larger than the other, so that any required length may be obtained by joining several together. The charge of powder being in its place, the priming tube is inserted and filled, it is then pressed against one side of the hole, and the sand is slowly poured in. A slender stick of hard-wood is rapidly worked up and down in the sand as it falls to the bottom, and thus every part becomes well packed. By this mode of operating there is, of course, no danger of communicating fire to the powder in the act of loading, an accident very liable to happen in blasting in the common way. The safest and most convenient method of firing the blast is by means of a small slip of paper which has been dipped in a solution of salt-petre, and dried.

It was intended to make examinations on other points connected with the phenomena observed by M. Burnand, but the requisite leisure has not been at command. The subject merits further investigation with a view to making useful practical applications of some of the remarkable properties which sand is found to possess.

On the manufacture of Military Projectiles, translated from the French of F. I. Clumann, Chief d'escadron d'artillerie, &c. &c. By Alfred Mordecai, *Captain United States Ordnance Department.*

(continued from p. 17)

Of the Lathe.

The lathe for turning cores consists generally of four stakes driven into the ground, and surmounted by a kind of rectangular frame of wood; the two pieces of this frame which stand in a direction perpendicular to the spindle of the core, may be called the transoms; their distance apart varies with the diameter of the core. The transom which is on the right hand of the workman, as he faces the lathe, has a copper gudgeon box to receive that part of the spindle which is next to the smaller base of the swell: this base should rest against the gudgeon when the spindle is on the lathe. The other transom is furnished with a square piece of iron, which forms the nut of a screw terminating in a point, and intended to support the end of the shaft, in which there is a small conical hole to receive the end of the screw. A crank, with a rectangular hole in it, is adjusted to the upper part of the spindle which it serves to turn. A weight suspended to an iron hook, prevents the spindle from leaving the gudgeon box.

Of the preparation of Sand Cores.

Cores of sand are formed on a nucleus of clay. The spindle is first placed in the lathe, turning the screw until the small base of the swell touches the gudgeon, so that the swell is between the two transoms. After having put in place the double hook to which the weight is suspended, the workman rolls a rope of straw around the spindle, making three or four turns. This rope is kept in its place by wooden pins, which are burnt during the process of drying and casting. He then applies several layers of clay, until the nucleus has the dimensions of the pattern. Before the nucleus is quite dry, several holes are made in it, in order that the sand may adhere more readily.

The model of the core is a copper box, divided into two parts by a plane through the centre, perpendicular to the axis of the eye. Its interior form and dimensions are those of the core, allowing a few points in excess for shrinking, if the projectile is of a large caliber. This shrinking cannot exceed three points in twelve inch shells; it is almost insensible in small ones.

One of the hemispheres of the box is terminated by a plane, and consequently remains open, when the shell is to have a culot; in the contrary case when the shell is to be concentric, that hemisphere is pierced at the pole, with a hole through which the sand is introduced, and which is afterwards closed by a cap. The other hemisphere, that which is first filled, has a hole of the diameter of the core of the eye, and is firmly fixed in a piece of wood which is let into a tripod stand.

The two parts of the box are connected by a groove, and fastened together by a ring which embraces the upper hemisphere, and which is confined by two hooks, acting at the extremities of a diameter.

To fill the lower hemisphere for the purpose of moulding the core, first place the spindle furnished with the nucleus, and with the core of the eye, which should be made of clay with great accuracy, calibered, and finished dry *on the lathe.* The swell of the spindle should rest against a small plate of iron fixed to the stand, so that the distance from the swell to the

core shall be constant, and equal to the distance from the traverse to the mould of the shell, added to the thickness of the metal. That thickness, measured at the eye of the shell, is then subject to no variation, if the traverses, the flasks, and the spindles, are perfectly alike, and if the latter correspond with the spindles of the models. In ramming the sand into the first hemisphere, the workmen should be careful to withdraw the spindle a little, and to be certain that it rests against the plate of iron above mentioned; for the ramming of the sand below the nucleus of the core tends to raise the spindle.

The rammers used are curved, and may be made either of iron or wood. When the box is perfectly full, the sand is leveled with a rule, then smoothed and compressed with a trowel, if the shell is to have a culot: if not, it is only necessary to fill the box by ramming closely, and to stop the hole with sand, which is afterwards compressed by applying the cap. To withdraw the core from the mould, the upper hemisphere of the box is taken off, whilst the lower remains fixed in the wood. The end of the spindle is inserted in a hole made in the stand; the core being then perfectly free may be trimmed at the seam, or circle of junction, which always leaves a kind of bur that it is necessary to remove.

The core when trimmed, is dipped into clayey water, made more glutinous by the addition of horse dung: very fine powdered coal is also added to the water: this coat of coal dust prevents the sand from adhering to the metal. If the mixture is not sufficiently adhesive, the powdered coal does not stick to the core, but becomes detached and floats on the metal, which causes large wrinkles about the eye of the shell. After this, the core is thoroughly dried; the least quantity of water remaining in it would either make the casting fail, or would produce great defects about the eye. It is always better to bake the core too much than too little, and failures are generally attributable to the neglect of this precaution. The purer the sand the more easily it is dried; but it is necessary to use sand containing a little clay, in order that the core may have the requisite consistence.

Common salt has the property of causing sand to harden very readily; a solution of salt, enables us, therefore, to use very loose sand, which is a great advantage; but cores made in this manner must be used immediately, for salt, being very hygrometric, would, in twenty-four hours, absorb water enough to spoil the casting. This method therefore can be used only under particular circumstances. Generally speaking, the cores should be exposed to a red heat, unless salt be used: they may be dried on the trunnel head without expense.

Of the preparation of Cores of Clay.

The nucleus is made in the manner before described, taking care to insert straw in the groove of the spindle when it is solid. It is dried at the doors of the furnace, avoiding immediate exposure to a red heat, and thus burning the straw. When the nucleus is dried, it is fixed better on the spindle, and prevented from slipping towards the swell, by means of a bit of slate introduced into one of the holes made in the spindle. After another layer of clay has been added to the nucleus, a second piece of slate is inserted in the hole at the end of the spindle. The core is then again dried, replaced on the lathe, and thus the operation is continued until it has received the requisite dimensions, calculated according to the dimensions of the projectile, and the contraction of the clay by a red heat. The number of layers given to each core, and consequently, the number of times it is dried,

varies with the caliber of the shell. At Hayange, five successive layers were formerly added to the nucleus for twelve inch shells, and two only for six inch or eight inch howitzes. At the furnaces of the Ardennes, the cores even for twelve inch shells were made in three layers. The process must necessarily differ according to the quality of the clay, its power of retaining moisture, and the degree of heat requisite for drying it. Although the dimensions of the last coat of clay given to all the cores, are regulated by the same pattern, calculated on the dimensions of the cavity and the contraction of the clay, the finished cores have never the same dimensions; they have not only lost their sphericity, but some have become too large, others too small. They therefore undergo another operation, called *dressing*. They are first examined by the aid of three instruments, the ring gauge, the half circle, which is a section of the core, and the caliber plate for the eye. The parts where they are too large are then scraped with a knife, and clay is added where the dimensions are too small. This operation is performed by hand, and there is consequently no certainty of accuracy. It is essential that the last coat of clay given on the lathe should be very thin, in order that the defects of form, which evidently result from the great contraction of clay by heat, may take place in the last layer but one, which ought to be so thick that the core before being dried, should have, at least, the dimensions it is to have when finished and dried. Instead of performing the operation of dressing by hand, it might be done on the lathe, by substituting for the pattern board a piece of iron, or tempered steel, and scouring the core with a paste of clay mixed with sand. The core of the eye should be turned when dry, and reduced with a chisel to its exact dimensions. This remark applies equally to cores of sand, and to those of clay. When the core has been dressed, it is blackened with coal powder, and again dried.

If the inspector, in verifying the cores with the gauge intended for that purpose, finds any that are too small, he should break them at once: because cores after having been dried and blackened cannot be increased in size. The workmen, who often judge erroneously of their own interest, and who moreover pay little regard to that of others, would secretly use these cores without alteration, with the hope, doubtless unfounded, that the defect of a projectile of which the metal should be too thick, would not be perceived in the inspections.

It is not so in the case of cores which are too large; they may be corrected by scraping and blackening them a second time. Generally speaking, the cores are blackened after having been dressed, and they are again dried.

The mere description of these different processes, shows that whatever degree of care is bestowed on cores made of clay, it is impossible, in making a great number, to have them exactly alike. It is therefore much better to make them of sand.

Of the preparation of the Mould.

To prepare the mould the workman places the upper hemisphere of the model on a board furnished with two battens, which enables him to seize it more easily underneath. He then inserts the spindle into the hole of the traverse, and places the *drag* on the moulding board. By turning the flask he makes sure that it touches the board, and that it rests against the swell of the spindle, which is an essential point. If the flask did not touch the board the projectile would be flattened, the polar diameter becoming too small: if on the other hand, the flask rested on the board, and the traverse did

not touch the swell of the spindle, the metal of the projectile would be too thin near the eye. These defects are but too often met with, because the flasks are warped out of shape. After the flasks have been properly placed, the gate is fixed; that is to say, if the shell is to be cast with the eye downwards; if the reverse, the vertical part of the gate would be placed in the sand of the cope. The workman supports with one hand the foot of the gate, which he adjusts on one side against the model, and on the other against the vertical part of the gate, around which he immediately packs a little sand. As his assistant fills the flask the moulder compresses the sand, either with his hand, in the angles, or in the middle, with a wooden paddle. If he is forming the mould of a large shell, he places the ears, and when the sand has reached a proper height, he presses the sand against them with his thumb, and supports the rings until they are fixed. As soon as the flask is entirely filled and the sand has been well rammed, the workman removes the superfluous sand with a rule, forms a funnel about the upper part of the gate, and with a needle pierces the sand in several places, to make vents, particularly above the ears. He then turns the flask on another board, furnished also with battens, and called the *false bottom;* he removes the moulding board, places the other hemisphere of the model in its groove, and lays the second part of the flask on the first, by making the dowels enter their corresponding holes; he sprinkles powdered charcoal on the model and on the sand, to prevent the fresh sand from adhering to the first, and fills the flask as he had before done, taking care to compress the sand a little more firmly if the projectile is to be cast with the eye uppermost. To remove the model the workman inserts a small bar of iron into the mortise of the spindle, slips under this bar a piece of wood, such as a paddle for instance, which resting on the sides of the flask, acts as a wedge under the bar, so that the model pressed against the sand, may not be displaced when the flask is removed. Turning the flask then on its side, he strikes a few blows with his paddle on the model, and detaches it, after having withdrawn the iron bar which confined it. He then places the model on a level board, fills the hole left by the spindle, and smooths the mould with the *mushroom* and the *sage leaf;* two small iron tools, which are used only for this purpose, and the forms of which are sufficiently indicated by their names.

The moulder uses the same method to remove the first hemisphere of the model: he withdraws the ears; lays the mould on a tripod stand without a top; places the core, measuring with a T the distance at which it should be from the equatorial diameter of the shell, and fixes it firmly either by inserting a key into the mortise of the spindle, or by driving nails between the stem of the spindle and the sides of the hole in the traverse. Having done this, he again joins the flasks and presses them closely together, either with key bolts, if the flasks are of cast iron, or with small hooks attached to the wooden flasks.

It is evident that if the two flasks were not pressed together sufficiently, the projectile would have a thick seam, which would be injurious to it, and it might also become too large in a polar direction. The latter cause added to the compression of the sand by the expansion and weight of the metal, often produces elongated projectiles. On the other hand they would be flattened, if in moulding, the flask rested only on the swell of the spindle, and left an interval between it and the moulding board. The flattening of a shell may also be occasioned by using too much sand to stop the hole of

the false spindle; it is therefore better to suppress the false spindle of the model for calibers of six or eight inches, as the flasks when filled with sand are still manageable.

To remove the model in that case, the two flasks are inverted together, a nail driven between the traverse and the spindle, and the hemisphere containing the eye is first removed.

Of casting and finishing hollow Projectiles.

The liquid metal should form a continuous stream, small at first, in order not to injure the mould. If the projectile is so large that the mould cannot be filled by a single ladle full, they should follow each other without interruption, and the contents of one should be poured into another, instead of being introduced immediately into the mould. The bottom of the ladle is of hammered iron, which the moulder covers with clay, with which he also lines the edge. He renews the lining at each casting, and dries it on the hot slag.

An assistant holding in one hand a piece of wood, and in the other a piercer, cleans the surface of the metal, and prevents the slag from running into the mould. It is necessary that the gases which are developed in the core should escape freely; if they do not immediately appear, either at the vents, or principally at the eye, where they ought to burn with a blueish flame, the assistant inserts his pierce in the groove of the spindle, and presents a piece of lighted wood, to set fire to the gases, and facilitate their escape. If the core has been badly dried, or if the sand of the mould is too wet, these gases are at first found in so great a quantity, that being unable to escape entirely, they prevent the metal from entering the mould; it then rises in the gate, and the casting fails. That accident may also happen if the metal is poured in too rapidly at first; without exactly rising, it sometimes receives from the same causes, a motion in the interior of the mould; in that case, little scales are formed on the projectile, which adhere but slightly to the mass of the metal, and which are easily detached with a hammer, particularly about the eye and the ears; this injures the shell and may become a cause of rejection.

A quarter of an hour after the casting, when the metal, though hard, is still quite hot, the upper flask is removed, and the gate detached with a hammer; the spindle of the core is then inserted in a winch and withdrawn. To draw out the spindles of sand cores, a greater effort is required than for those of clay, because the straw which envelopes them is more burnt in the latter, on account of the greater heat to which they are exposed in drying.

The bur which is formed about the eye is next removed with a rasp. This operation requires particular care, to prevent breaking the eye, which would almost always happen if it were rasped at too low a temperature, or if the bur were too thick; this occurs when the swell of the spindle of the core does not exactly fill the cavity formed by that of the model, the greater base of which is a little smaller than the orifice of the eye. The requisite dimensions are given to the eye by means of a six sided reamer, and they are verified by a gauge. The eyes, which from the inattention of the workman, are not sufficiently large, are afterwards reamed out when cold: a countersink in the form of a very obtuse truncated cone, serves to remove the sharp edge of the eye.

It is advisable to remove the projectiles out of the foundry while they are yet hot, in order to sprinkle water on them, and facilitate the removal

of the sand. But this sprinkling of water increases the contraction perceptibly: attention should therefore be paid to it, in determining the dimensions of the model.

When the projectile has become cold, it is handed over to the finisher who places it on a bench composed of two pieces that do not touch each other, between which it is secured by means of wedges. He breaks the core with a hook and a kind of chisel, turns the shell several times, to empty it entirely, and by means of a hammer and a rasp, removes the sand which still adheres to the surface. This sand adheres more strongly in proportion as it contains more clay; it is often necessary to chip the metal in order to remove the sand entirely. This facilitates oxidation, and injures the appearance as well as the quality of the projectile. We have indicated the method of preventing this defect, by mixing the sand with the dust of mineral coal, coke, or charcoal, and by wetting the projectiles immediately after they are cast. The seam and any roughness of the surface are removed by the chisel.

Projectiles which are of irregular dimensions should be always rejected, unless they can be ground to a proper form. Permission is sometimes given to dress with the chisel a certain number of these defective projectiles, which produces very bad results; especially if it be necessary to remove the metal on a large portion of the surface of the shell. Those which are carefully ground have a very handsome appearance; but, in common with those which are dressed with the chisel, they have the great fault of being liable to rust.

Of the manufacture of Shot.

Shot were formerly cast in iron moulds, called *shells;* they were afterwards hammered. It is about ten years since the casting of them in sand commenced: a great improvement, which however, is not yet definitively adopted.

The iron moulds consist of two equal parts, which are let into each other: each half is furnished with two handles. The gate, which is very wide at the mouth, is placed at the highest point; the plane of junction or rather the joint, is vertical at Hayange, and horizontal at some other founderies, as for instance at those of Niederbrunn.

The models for these moulds are made of copper, encased in wood to prevent their being altered by use. The inner surface of the copper serves to make a core of sand which forms the cavity of one half of the mould. As the exterior surface of the moulds may be left rough and uneven, they are cast uncovered; that is, the model is merely impressed in the sand, and removed without covering the hollow thus made, which is then filled with the liquid metal. In this way large objects, of which the under surface only is required to be exact, are generally cast. In this way it is evident that the joint of the mould is horizontal when it is cast. The interior of these moulds is not spherical. The vertical radius is smaller than the horizontal, which is that of the joint. The following differences are allowed, $3\frac{1}{2}$, 3, $2\frac{2}{3}$, $2\frac{1}{3}$, 2, $1\frac{2}{3}$ points, for the calibers of 24, 16, 12, 8, 6, 4, respectively. These data have been furnished by experience.

These moulds produce, therefore, spheroids flattened in the horizontal direction, perpendicular to the plane of junction. The shot obtained from them are consequently a little reinforced at the seam or bur occasioned by the joint, and it is necessary that they should be so; because that part re-

ceives under the hammer, a great number of blows which tends consequently to diminish this great circle and to increase those perpendicular to it.

In many founderies it is moreover customary to remove the bur with the rasp, when the shot have been heated for hammering; that operation, which is very bad, as we shall see, also requires that the projectiles should be larger at the seam when they leave the mould.

In casting shot, the two parts of the mould are joined together, after having been washed with muddy water. They are placed on a piece of cast iron furnished at the two extremities with two arms, which serve to hold the moulds, and by means of which they can be wedged together. It is to be observed that the gate should be vertical, and the handles turned outwards. They are connected in sets consisting generally of about twenty moulds.

The metal is dipped out from the crucible of the furnace with ladles, and is poured into the moulds in a regular stream, care being taken to skim it constantly.

Of casting Shot in Sand.

The moulds for shot are made of sand in a manner similar to those for howitzes. When this method of fabrication was first ordered in the department of the Moselle, in 1824, it was directed to roll the shot in an iron cylinder before hammering them. We had already made in this manner, in 1821, about fifty shot, which we showed to Lieut. Gen. Tyrlet, who thinking them very good, took several of them to show the committee of artillery.

Our experiments were varied in different ways. We used both the metal which furnishes brittle iron, and which is generally used for making projectiles, and the metal of tough iron, with which carriage flasks were then made; the shot were either rolled, or hammered, or else rolled first and then hammered.

The following are the conclusions which we have derived from these experiments:

1st. Shot first rolled and then hammered, are very superior to those which have undergone only one of these operations.

2nd. Hammering cannot be advantageously replaced by rolling; if we do not wish to adopt both of these operations, it is infinitely better to retain the former.

3rd. The ore of tough iron gives shot of a more even surface than the ore of brittle iron.

4th. The small cavities which often appear at the upper pole of a shot, occur as frequently with one of these kinds of ores as with the other.

It is to be remarked that the small cavities in question, and of which we have already spoken, are not found in all kinds of cast iron. There are founderies in which this defect is scarcely known; shot made of white metal are always free from them; but they have others still greater. We shall return to this subject in speaking of rolling, hammering, and inspecting shot.

Of Models for Shot.

The models of shot resemble those of hollow projectiles; but they have only one spindle, which is pierced at the upper end with a mortice to receive a small ruler, and is of use only for removing the model. If shot are to be only rolled, or to be hammered after rolling, the models should be

spherical, except that of the twenty-four pounder shot, because the weight of this projectile may compress the sand, and cause it to give way unless it is very firmly rammed.

The models of shot which are to be hammered without first rolling them, should be made a little full at the plane of juncture. For this purpose they are flattened in the contrary direction; if of a heavy caliber this flattening should commence at a considerable distance from the poles. The reasons for adopting this form have been already given.

We have often remarked that all projectiles undergo a slight depression along the seam, both above and below; this fact is probably connected with the phenomenon of the contraction of a fluid vein escaping from an orifice. It would follow that all the models ought to be a little full at the plane of junction; but it is not so, because the workman striking gently on the models to disengage them from the sand, cannot avoid enlarging the mould at the equatorial diameter: the small increase of diameter which results from this cause, compensates for the depression alluded to.

The form of the moulds in different cases, should therefore be governed by the reasons heretofore stated.

In turning the models they are at first made spherical; if necessary, they are afterwards flattened, according to a particular pattern cut out of sheet iron, which serves as a guide. These models should rather be made too large than two small, as we have before remarked, because they can be easily reduced, but cannot be enlarged. But with the same model and the same metal we may obtain larger or smaller shot, according to the manner of ramming the sand.

The foot of the gate ought to be thin and broad; the angles at the end which touches the model, should be a little chamfered, in order that the gate may be more easily detached.

Of Moulding and Casting Shot.

Several shot may be cast at one time in one flask, by arranging the moulds in two rows, between which is placed a principal gutter, running through the whole length, from which the metal passes into the moulds by small channels terminating at each mould.

For this purpose there are first placed on the moulding board, the model hemispheres without spindles, and the gates according to the arrangement they are to have. The moulder fills the flask, packing the sand as it is put in, smooths it, opens the mouth of the gate, makes five or six vents with a piercer two lines thick, and turns the flask on a *false bottom.* He afterwards puts in their places the other hemispheres furnished with spindles, sprinkles powdered charcoal on the model and on the sand to prevent the adhesion of the fresh sand, places the second part of the flask, taking care to fasten the hooks or bolts, and fills it, compressing the sand more closely than in the first flask, especially if the shot are of a large calibre.

To remove the model, the workman introduces small rulers in the mortises of the spindles, takes off the flask which he has last filled, lays it on its side, proceeds as has been directed for the shells, and joins the two flasks again, fastening the hooks or key bolts which secure them together: the mould is then finished.

The metal should be poured in more slowly in proportion as it is more liquid. The size of the gate ought to vary, indeed, with the degree of fluidity of the metal; but this is not practicable.

When the metal begins to become solid, the flask should be turned upside down. It has been observed that when this is not done, a cavity or at least a slight depression, is formed at the superior pole, which is prevented by upsetting the flasks. The bubble of gas which causes it, being thus driven back towards the centre, does not occasion so great a displacement of the centre of gravity, and the shot becomes more spherical. It is very important to seize the proper moment for turning the mould, which varies from one day to another, if the metal is not the same.

It is particularly this defect observed in shot cast in sand, and seldom in those cast in iron moulds, which has caused doubts as to the preferable method. The decision has been at length made in favour of the former, on account of the greater accuracy of dimensions and form in the shot thus made, and of the smoothness of their surface. We are of opinion that if shot cast in iron moulds, which are otherwise very imperfect, have not the defect we have just mentioned, it is to be chiefly attributed to the position of the gate, which is straight and terminates at the highest point of the mould. This arrangement could not be made for shot cast in sand moulds; the gate must necessarily be placed at the plane of junction, in order that the metal may run along the inner sides of the mould, without falling suddenly on the bottom, which would not fail to injure it. But the cause of the defect being known, we immediately see a radical remedy; instead of removing it at the expense of the density of the shot, it will be sufficient to make at the upper pole of the mould a very large vent, like a gate, to place the mould carefully in a horizontal position, to increase a little, if necessary, the height of the upper flask, in order that the liquid metal may be subjected to a greater pressure, and to pour in the metal very slowly towards the last. When the shot are cold they are trimmed: this operation is often performed with a hammer, and in a very rough manner, when the shot have been cast in iron moulds: a remedy is afterwards attempted, when they are hammered, by rasping them while hot, which is very faulty. It is important that the shot should be carefully trimmed with the chisel, especially if they are to be only rolled afterwards.

(TO BE CONTINUED IN OUR NEXT.)

Suggestions in regard to regulations for the safety of Steam Boilers. By A. C. JONES, *Engineer.*

In the law proposed during the last session of our Congress, for regulating steam vessels, I find that some very essential matters are entirely unnoticed; some of these I propose to pass in review. First. Nothing is said about having an additional safety valve to the boiler. This, however, is admitted to be a necessary appendage, as it is of importance that one of the valves should be secured by fixing a box or basket over it, to prevent it being overloaded. The regulation adopted abroad, for keeping the lock-up valve from adhering to its seat, namely, to examine it at stated times, is imperfect, as I have known valves to cement to the seat in a few hours from the time of examining them. The following simple arrangement would serve to keep the lock-up valve free. Suppose the valve to be loaded with a weight placed upon it; to the top of this weight a cord, or small chain, is attached, and passing through the cover of the box, is carried over a pulley and made fast to the cord connected with the valve, under the engineer's charge, and by which he raises it. It is evident that when the engineer

raises his valve, the other will be opened simultaneously, and consequently the lock-up valve will be prevented from cementing.

In the seventh section of the law referred to, directions are given how the engine shall be managed at stopping places. The method in common use for slacking the fire is to open the furnace doors, and nearly to close the damper. If it were entirely closed, the flame would come out at the furnace door. This method is, however, very defective. I have found by experience, that steam will be generated as fast for a limited time, under these circumstances, as if the fire was in active combustion. No cold air, or very little of it, enters the fire doors, for the simple reason that there is no outlet for it, and the active heat in the fuel will, therefore, keep the steam high, even when the engine is running. I have run a large engine with anthracite coal, which being fairly ignited, I have kept the damper closed for hours, the combustion being meantime maintained, the air passing through the crevices around the damper. The reasoning supported by the fact just stated, proves conclusively, that the generation of steam will not be *quickly* checked by the common methods of damping. To effect this purpose, the arrangement of the furnace should be such that the ash pit, or pan, could be closed so effectually as to prevent air passing through the grates. The damper and fire doors being then opened, the cold air passing over the surface of the fuel, will cool the boiler in its passage. The proposed regulations have omitted to establish any rules for cleaning the boilers. These, of course, would have to vary with circumstances, but should be laid down as carefully as possible. The proposed regulations will be productive of greater safety, by making engine builders pay more attention to the construction of the boilers. If the steam chimney of the Wm. Gibbons, or of the Ohio, had had stay bolts to connect the flue with the shell in that part above the roof of the boiler and rings, shown in the annexed cuts, enclosing and riveted to the flue, no collapse of the flue would have taken place. I suggested this arrangement to a boiler maker several years since, and his answer was "that the plan was good; but as long as the old method answered, there was no necessity for incurring additional expense."

Fig. 1

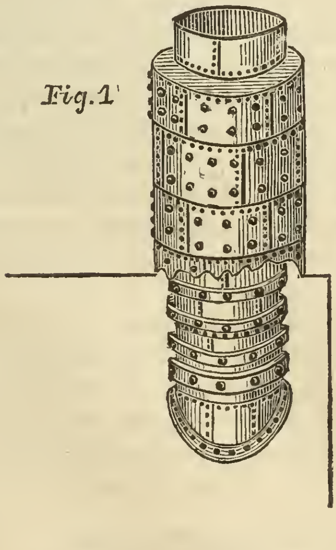


Fig. 1st, shows the steam chimney as strengthened by the stay bolts and rings.

Fig. 2.

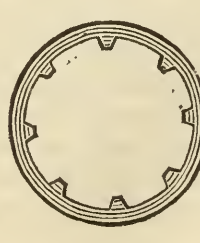


Fig. 2nd. One of the rings, the internal projections, being in contact with the flue, with rivets passing through them.

Portsmouth, May 25th, 1836.

Further remarks, on suggestions, by Mr. Perkins, in regard to the Explosion of Steam Boilers. By a Correspondent.

In the June number of this Journal,* I commenced an examination of certain suggestions in regard to the explosion of steam boilers, by our countryman Mr. Perkins. The examination was made by the light of *direct experiments* by the Committee of the Franklin Institute, on the explosion of steam boilers. It was there shown that the following suggestions of Mr. Perkins are erroneous, viz: First, that the gradual increase of pressure within a steam boiler, cannot produce all the effects of the most violent explosions. Second, that the projection of water into hot and unsaturated steam, can produce highly elastic, or explosive steam.

I now propose to apply the experiments of the Committee above referred to, to test the further suggestions contained in the article under examination.

It has been seen in the preceding essay that Mr. Perkins assigns as one cause of explosion, that water gets too low in a boiler. Then according to him, the metal becoming heated forms unsaturated steam which rises, and water being thrown into it, is flashed into explosive steam.

In justice to the very direct experiments of the Committee on explosions, I ought to have inquired whether surcharged steam could exist in a boiler containing water. Whether such steam would not take up water and become, in a greater or less degree, saturated. But as the answer would have been favorable to the statement, that unsaturated steam might so exist, I passed on, taking the circumstances to be as stated by Mr. Perkins. The reader will, however, find this point fully settled in the answer to the fourth inquiry of the Committee.† A fire being made upon the top of a boiler, while the quantity of water within was kept at about 308° Fah., the steam became highly surcharged, so as to attain a temperature of 533° Fah. This surcharged steam remained above the water, which varied from three inches to .9 of an inch in depth, more than two hours, its pressure not rising above seven atmospheres; while saturated steam of the same temperature would have had a pressure of more than *sixty atmospheres.* These experiments stood a severe test, now to be described. Setting out with steam of 308½° Fah., the pressure of which is 5.2 atmospheres, if heat be applied to expand it as a gas, supposing no water to be taken up, the steam will have, by calculation upon the known rate of expansion, a pressure of 6.75 atmospheres.‡ As satisfactory a coincidence, with the pressure actually measured, and which is stated above, as could be desired.

Though this hot steam may exist in a boiler, there seems no occasion to guard against its remaining, or to look for a method to indicate its existence, since it is proved that the projection of water into it will diminish, not increase, its pressure.

I proceed next to examine the effect of water thrown upon hot metal, and it will be seen that Mr. Perkins is fully borne out, in assuming this as a source of *very great danger*; that he should, in fact, have looked entirely, to the heated metal itself, as the cause of explosion, and not to the surcharged steam which it may produce. The committee on explosions took the course, involving assuredly some personal danger, of making a di-

*See page 369, vol. XVII. † p. 73, vol. XVII. Jour. Frank. Inst.
‡ Ibid. p. 74.

rect experiment on this point.* The bottom of the experimental boiler being heated to a red heat, water was injected by the forcing pump, and the pressure obtained ascertained by a gauge. In every case the pressure rose very rapidly.

"In the last experiment, the glass window at the fire end of the boiler, blew out with a quick, sharp report, as loud as that of a musket; the fragments of glass, from a hole in the centre of the plate, were projected through a window, about three feet from the boiler, and could not be found. The number for twelve atmospheres is placed opposite to this experiment, as being an approximate result. In the act of observing the gauge, the glass window burst, and the mercury at once fell: the number of inches at which the mercury had certainly risen, and above which it was, by an undetermined quantity, not however very considerable, was noted; and from this the pressure given in the table is calculated. Here explosive steam is generated by the injection of water upon red hot iron, and in a time not exceeding one or two minutes at the most, the interval between the last stroke of the pump and the explosion, not having been sufficient to note the height of the gauge; the experimenter being at the pump, which was adjacent to the gauge."

The glass window referred to, we are elsewhere told, was three-eighths of an inch thick, and its dimensions were two and a half by one and three quarter inches.

Here then, by the injection of a limited quantity of water, which it is stated was not sufficient to cool the metal to the temperature at which it would have produced steam most rapidly, a bursting pressure of eleven atmospheres was rapidly produced.

Some experiments originally made by Klaproth, and repeated by Mr. Perkins, seemed to show that water thrown upon very hot metal, was so entirely repelled by it as to generate but little steam. Indeed, this has been regarded as a stumbling block in the way of the theory, which assigns to the hot metal so important a part, in producing explosions. It was this, probably, which led Mr. Perkins to abandon the idea that heated metal is the source of danger, in favour of the hot and unsaturated steam. It was the consideration of such results, that induced Mons. Arago† to say, that in order to complete this theory, which he attributes to Marestier, it must be shown why the water in a boiler acts differently when thrown upon hot metal from the small drops in the iron spoon, in Klaproth's experiments. The committee of the Franklin Institute, have not only proved the fact to be that explosive steam may be produced by throwing water on red hot metal, but have supplied an answer to the difficulty just referred to, by an elaborate series of experiments‡ on the vaporization of different quantities of water in metallic vessels of different materials, thicknesses, states of surface, &c. and have pointed out the influence of all these circumstances on the rapidity with which water is converted into steam. The effect of pressure in modifying the results was appreciated in their first experiment.

The direct experiment before referred to, being sufficient to meet Mr. Perkins' views, I pass on for the present, intending to recur to these other experiments, for information quite as important as the fact under review.

If then the water in a steam boiler should fall below its proper level, the portion of fire surface exposed without water, could become unduly heated as in the experiments of the committee. But how are we to find the water to be thrown upon the hot metal? Mr. Perkins answers this question, by

* Ibid, p. p. 14, 15. † Annuaire du bureau des Long. 1830, p. 191.
‡ Jour. Frank. Inst. vol. XVII. p. p. 90, 91, &c.

supposing the safety valve to be "suddenly raised, the water will [then] be relieved from the steam pressure," and rush up, and "that part of a boiler which has been raised in temperature, giving off its heat to the water so elevated, steam is generated in an instant, &c."

Is it the fact, as here asserted, that water when relieved from pressure, does rise ihto foam? Again, when that foam is thrown upon the sides of the boiler, does it generate more steam than is sufficient to compensate for the loss of steam which produced the diminution of pressure and thence the foaming?

When M. Arago wrote his essay on the explosion of steam boilers, he could not decide the first of these questions; he brought general analogy to bear in favour of the probability that this foaming was produced. The experiments of the committee on explosions have supplied, completely, the desired information. They examined the question in its bearing "upon the apparatus designed to show the level of the water within the boiler," and also upon the question now before the reader.*

"The first experiments on the effect of relieving water in ebullition from pressure' were made in a glass boiler: here the fire was under the whole length of the boiler, which was a cylinder of fourteen and a quarter inches in length, and seven and a half inches in diameter. The steam within, being at a pressure of less than two atmospheres, by opening a cock at the end of the boiler, or the safety valve, also at the end, large bubbles were formed through the whole extent of the boiler.

The inquiry was prosecuted in the iron boiler already described, a distinct view of the interior being had through the glass windows placed in the heads. The greatest intensity of the fire was in front of the middle of the boiler, and extended through about one-third of its length: the part immediately near the flue, was next to this band in temperature. With this boiler experiments were made, which showed, that on making an opening in the boiler, even when the pressure did not exceed two atmospheres, a local foaming commenced at the point of escape, followed soon by a general foaming throughout the boiler, the more violent in proportion as the opening was increased. This small boiler was completely filled with foam by opening the safety valve, (nearly two-tenths of an inch in area) which was placed on the middle of the top, and the water violently discharged through the opening of the valve. The area of the valve bears to the horizontal section of the boiler, at the water line, the ratio of one to two thousand and fifty-five nearly. The boiler was half full of water in these experiments."

To show the extent to which this foaming may take place, I quote an experiment in point.

"The steam in the boiler being not higher than two atmospheres, the following experiment was made. The level of the water was reduced until it stood just below the lowest gauge-cock. On opening this cock, steam at first flowed out, then water and steam; on opening the second cock, in addition, water flowed freely from the lowest, which was above the hydrostatic level; the foaming within the boiler, which was produced by thus relieving the pressure, was distinctly seen through the glass windows. On opening the third cock, steam and water issued from the second, which was two inches above the water level; and on partially raising the safety valve, water flowed freely from the second cock. A further rise of the valve filled the boiler with foam, water flowed freely out of the third cock, more than three inches and three quarters above the water level, and finally through the opening of the safety valve itself. In these experiments, an opening of .03 of a square inch in area, the lowest cock, which, to the area of the water surface, was as one to thirteen thousand seven hundred, caused water and steam to issue through a cock, below which the water was known to be. A further opening of .03 of a square inch, making, with the first, .06 inch, or one six thousand eight hundred and fiftieth the area of the water surface, brought water from the lowest cock; a total opening of .09 inch, (one four thousand five hundred and sixty-seventh of the area of the water surface) brought water and steam from the middle

* Jour. Frank. Inst. vol. XVII. p. p. 8, 9, &c.

cock, indicating that the level of the water was nearly two inches higher than it really was.

A first apparatus, which was contrived for applying fusible plates to the boiler, suddenly opened an aperture of .95ths of an inch in diameter. Even at low pressures, the scalding contents of the boiler were violently discharged through this opening, against the roof of the experiment house."

But after all, will the steam produced by this foam coming in contact with the heated sides of a boiler, be greater in quantity than the escape steam which produces the foaming? M. Arago says, that in experiments which he made on the effect of opening a safety valve, the pressure was always diminished. But he remarks that the boilers on which he experimented had their full supply of water. His results do not therefore, decide the question. Indeed, the question being one of degree, is a difficult one. The Committee of the Franklin Institute endeavored to imitate the circumstances to be found in a boiler in which the water is low. Having allowed the water to waste, the bottom of the boiler above the water level became heated; openings of different sizes were made in succession, so as to produce different degrees of foaming. In every case an opening produced a diminished elasticity of steam.*

M. M. Tabareau and Rey of Lyons,† found a different result by surrounding a small high pressure boiler with flame, allowing the water to become low, then opening a large stop cock. The pressure was increased.

These results do not contradict each other, they show that an increase of pressure may or may not be produced, *according to the quantity of hot metal present.* No one would probably venture upon making an opening under circumstances in which it was a mere question of degree whether the boiler would burst or not. At the same time the experiments of the committee led us to look further for causes to produce explosion from heated metal, by a sudden access of water. The choking of a forcing pump and the sudden removal, by the action, of the pump of the obstruction, the sudden introduction of water when it has been found very low, without putting out the fires, are occurrences which would produce a certain result. The last is entirely within the control of the engineer. In connected boilers occupying the breadth of a boat, the careening of the boat will cause just such a state of things. If continued long enough it cannot fail to produce an explosion.

Wherever there is unduly heated metal there is danger, and that danger may be actually increased by making an opening into a boiler, is the inference from this examination. Before leaving this subject, and after differing in the former essay entirely from Mr. Perkins, I am so well pleased to find some part of his suggestions well founded, that I am disposed to dwell upon it, I propose to examine whether the danger of explosion from hot metal will probably increase with the temperature, or not.

Finding that drops of water are repelled from heated metal at quite moderate elevations of temperature, the result has hitherto been assumed, as applying to the case of a steam boiler, of which the metal is unduly heated. Reflection will show that this is not the case, the heated metal is cooled by the very act of generating steam. The rapidity of the supply of heat is also to be taken into account. If the metal is directly above the fire receiving heat, the result will be very different from what would take place, were the heat derived from conduction, through the medium of other heated

* See Jour. Inst. p. 14. †Ibid, p. 13.

parts of the boiler. The problem is in some sort indeterminate. This has been pointed out in the report of the committee on explosions, and experiments have been devised by using different modes of applying heat, to give an idea of the true state of the case.*

They began by showing the early development of a repulsion in the heated metal, tending to diminish the vaporization of water, taking place when the quantity of water is too small to cool down the metal, at a lower temperature in copper than in iron, in a clean surface of metal than in one which is oxidated. This repulsion, preventing the effect of the increased difference of temperature in the metal, and the water to be vaporized produces a maximum in the vaporizing power of the metal. The vaporizing power of different metals at their maximum is different, being greater in copper than in iron, nearly in the ratio of the conducting powers of the metals. An important practical conclusion where the heat of the metal is kept up, as the temperature of greatest vaporization lies below that of our high pressure engines.†

By increasing the water, from drops to as great a quantity as the bowls, used in the experiments, would contain, and varying the circumstances by communicating heat to the metal through oil, and through tin, the Committee proceeded to examine the question now before us. While the quantities of water were small, great regularity appeared in the results, permitting a calculation of the temperature of greatest vaporization from results below that temperature.‡ The general conclusions are stated briefly thus:§

1st. The vaporizing power of copper, when supplied with heat, by a bad conductor or circulator, such as oil, increases with great regularity as the temperature increases, up to a certain point, the water being supposed thrown upon the copper surface, in small quantities. Copper flues, heated by air passing through them, would be in this condition if left bare of water, and then suddenly wet. This holds with copper one-sixteenth of an inch thick, without indication that a limit will be attained by a much more considerable thickness. The temperature at which the metal will have the greatest vaporizing power, is about 570° Fah., or about 230° below redness, according to Daniell.

The law of vaporization of small quantities of water, by a given thickness of copper, is represented with singular closeness by an ellipse, of which the temperatures represent the abscissæ, and the times of vaporization the difference between a constant quantity and the ordinates.

2d. The same power in thin iron, .04 inch thick, increased regularly, and was at a maximum, probably, at 510°. With thicker metal the power increases more rapidly at the lower temperatures, and varies very little, comparatively, above 380°, with thicknesses exceeding one-eighth, and less than one-fourth of an inch; attaining a maximum at about 507° Fah., when the quantities are small; rising to 550°, and much above, as the quantity of water is increased relatively to the surface of the metal which is exposed. Quadrupling the quantity of water, the entire amount being still small, nearly tripled the time of vaporization at the maximum.

3d. When copper of one-sixteenth of an inch in thickness, was supplied with heat by melted tin, a worse conductor, and having a lower specific heat than copper itself, the time of vaporization, in a spherical bowl, of quantities varying from one-sixteenth to one-half of the entire capacity of the bowl, increased but three-fold, and the temperature of greatest evaporation was raised by 56°, or from 470° to 526°. When the bowl had half of the portion which was exposed to heat filled, the weight of the water was about one and one-tenth of that of the metal.

4th. The times of vaporization of different quantities of water, varying from one-eighth of an ounce to two ounces, in an iron bowl one-fourth of an inch thick, and supplied with heat by the tin bath, were sensibly, as the square roots of the quantities, at the temperatures of maximum vaporization for each quantity.

* Jour. Frank. Inst. vol. XVII. p. 152. † Ibid. See p. p. 150, 151.

‡ Ibid. p. p. 152, 153, &c. and plates 5 and 6. § Ibid. p. p. 162–3.

These temperatures were raised from about 460° to 600°, by increasing the weight of water about sixteen times, indicating that considerable quantities of water, thrown upon heated metal, will be most rapidly vaporized when the metal is at least 200° below a red heat.

5th. While a red heat, visible in daylight, given to a metal, even when very thick, and supplied by heat from a glowing charcoal fire, does not prevent water, when thrown in considerable quantities, from cooling it down so as to vaporize the water very rapidly, it is much above the temperature at which the water thrown upon the metal will be most rapidly evaporated. Thus one ounce of water was vaporized in thirteen seconds, at about 550°, in a wrought iron bowl one-fourth of an inch thick, and required 115 seconds to vaporize in a cast iron bowl one-half an inch thick, at a red heat. Four ounces in the latter bowl vaporized in about 300 seconds, the bowl being red hot when it was introduced; and two ounces vaporized in thirty-four seconds at 600° Fah.

6th. The temperature of greatest vaporization, with a given thickness of metal, is lower in copper than in iron, the repulsive force being developed at a lower temperature. With equal thicknesses of iron and copper, the vaporizing power of the latter metal, at its maximum, was, with the oil bath, one-third greater than that of the former, and with the tin bath the power of copper .07 of an inch thick, was equal nearly, to that of iron, one-fourth of an inch thick, each being taken at its maximum of vaporization, for the different quantities of fluid employed. As the maxima for the iron are higher than those for the copper the advantage will be still greater in favor of copper when the two metals are at equal temperatures.

7th. The general effect of roughness of surface is to raise the temperature at which the maximum vaporization occurs, and to diminish the time of vaporization of a given quantity of water at an assumed temperature below the maximum.

8th. Though it has been shown that water thrown upon red hot metal is adequate to produce explosive steam, even when it does not cool the metal down to the temperature of most rapid vaporization, it is not the less true that metal more than two hundred degrees below a red heat, in the dark, is in the condition to produce even a more rapid vaporization of water thrown upon it, than when red hot.

We thus acquire a certainty of this remarkable fact, that a boiler may be in a more dangerous condition; (that is, in a condition more fit to produce *suddenly* highly elastic steam,) when below a red heat, from water thrown upon the metal, than even when the danger shows itself by the luminousness of the metal. Although, as we have seen, explosion may be produced at a red heat.

We are by all this plainly directed to the necessity for keeping up the supply of water in a boiler. A keen interest is excited as to the means of ascertaining this level. The necessity for methods of showing when the metal of the boiler becomes hot, before it has reached the point when it becomes dangerously so, is clearly proved. All these important practical matters the reader will find treated of, in the report from which I have drawn the materials of these essays.

But to return to the theory of Mr. Perkins. We have followed up two of his positions, and have now arrived at the third. "The *third* and less frequent kind, [of explosion] although most terrific, is undoubtedly caused by an explosive mixture having been formed in the boiler." This "third kind" I propose to examine by the same light which has enabled us to separate truth from error in the first and second. D.

Physical Science.

Communication of a formula for facilitating the reduction of observations of the solar eclipse of May 15th, 1836. By S. C. Walker.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen: The formulæ communicated by me in the April number of the Journal, were intended for announcing the time of the principal phases

of the solar eclipse of May 15. By applying a correction derived from observations made under a known meridian, they may be used for determining the longitude of places at which it was observed, when not too far distant from Philadelphia, for which place alone, they are strictly correct. The error of the middle time of the eclipse, as deduced from the formula, amounts to one second of time for New York and Albany, to two seconds for Baltimore and Washington, and to eight seconds for Boston and the University of Virginia. By applying to the middle time by the formula, a correction depending upon the first and second powers of the difference of longitude from Philadelphia, results may be obtained, in which the greatest variation from a rigorous computation for the above places, will in no instance exceed 0.6 sec., and in which the average discrepancy will not exceed 0.4 sec. In the former communication it was omitted to mention that l, denotes the *geocentric* latitude of the place for which the computation is made.

Retaining the same notation and constants as before, we have for the resulting longitude of the place of observation from Greenwich, +East—West

$$\lambda = A + B + C$$

Where,

$$A = \lambda' + x + \left\{ M - M' \right\} - [8.8557] \left\{ D - D' \right\}$$

$$B = [4.9781] \left\{ 5\text{ h. } 0\text{m } 40\text{s.} + A \right\}^2 - [7.1701] \left\{ 5\text{h. } 0\text{m. } 40\text{s. } + A \right\}$$

$$C = -\tfrac{1}{5} \left\{ A + B - \lambda' \right\}$$

In these equations

λ' = Assumed longitude from Greenwich, in seconds of time.
M = Local mean time of middle, observed.
M' = do. computed by formula.
D = Duration, observed,
D' = do. computed,
x = A correction for the errors of the tables.

The unknown quantity x, is the mean of the times at beginning and end, in which the moon by its apparent motion, traverses a space equal to the tabular error on its true orbit, projected upon its apparent orbit. No material error will arise from assuming x, as constant for the limits to which this formula extends. Of the extent to which it may be used, an opinion may be formed from the following table, in which the middle time $M' + B$ derived from it, is compared with the rigorous computations for several places in the American Almanac.

Place.	M′	B.	Middle by Formula M′ + B	Middle by Am. Almanac.	Difference.
Philadelphia,	8 17 55.35	+ 0.00	8 17 55.35	8 17 54.75	+ 0.60 s.
Boston,	8 42 30.80	+ 7.73	8 42 38.53	8 42 38.90	— 0.37
Providence,	8 39 42.55	+ 6.31	8 39 48.86	8 39 48.65	+ 0.21
Albany,	8 30 11.15	+ 0.60	8 30 11.75	8 30 11.80	— 0.05
New York,	8 25 1.45	+ 0.32	8 25 1.77	8 25 1.65	+ 0.12
Baltimore,	8 9 40.95	+ 1.69	8 9 42.64	8 9 43.20	— 0.56
Washington,	8 6 58.30	+ 2.56	8 7 0.86	8 7 0.30	+ 0.56
University of Va.	7 58 10.33	+ 7.37	7 58 17.70	7 58 18.15	— 0.45
					8)2.92
Greatest difference, 0.6 sec.				Mean difference, 0.36 s.	

The determination of x, requires observations under known meridians. This eclipse having been visible at European observatories, the value of x, will admit of accurate computation. If we assume the longitude of Independence Hall, Philadelphia, at 5h. 0m. 40s. west from Greenwich, we shall have, after correcting for the small differences of longitude of several places of observation in Philadelphia, the following values of x,

By the observations of	R. M. Patterson, M. D.	$x = -$ 11.15 sec.
"	T. M'Euen, M. D.	$x = -$ 9.67
"	W. H. C. Riggs,	$x = -$ 11.40
"	S. C. Walker,	$x = -$ 11.93
		44.15
Mean of four observations,		$x = -$ 11.04

As an application of the formula, let it be required to deduce the longitude of the Capitol at Washington, from the observations of F. R. Hassler, Esq. Latitude 38° 52′ 54.″ Beginning observed 6h. 53m. 58s. End at 9h. 20m. 8s., A. M. Mean time.

Computation of the longitude of the Capitol.		1st. Approximation.	2d Approximation.
(1)	assumed λ'	— 5h. 8m. 7.20	— 5h. 8m. 10.02
(2)	assumed λ	— 11.04	— 11.04
	M	+ 8 7 3.00	+ 8 7 3.00
	M′	+ 8 6 58.30	+ 8 6 54.88
(3)	M—M′	+ 4.70	+ 8.12
	D	+ 2 26 10.00	+ 2 26 10.00
	D′	+ 2 26 13.60	+ 2 26 12.24
	D—D′	— 3.60	— 2.24
(4)	— [8.8557] {D—D′}	+ 0.26	+ 0.20
(1)+(2)+(3)+(4)	A	— 5 8 13.28	— 5 8 12.74
	5h. 0m. 40s.+A	— 7 33.28	— 7 32.74
(5) ...	+ [4.9781] {5h. 0m. 40s.+A}^{2}	+	+ 1.92
(6) ...	— [7.1701] {5h. 0m. 40s.+A}	+	+ 0.67
(5)+(6)	B	+ 2.56	+ 2.59
	A+B	— 5 8 10.72	— 5 8 10.15
	A+B—λ'	— 3.52	— 0.13
	—$\frac{1}{5}$. {A+B—λ'} =C	+ 0.70	+ 0.03
A+B+C	= λ	— 5 8 10.02	— 5 8 10.12

Similar computations from John Gummere's observations, give the longitude of Haverford School.

Observed beginning		7h.	3m.	24.5s.
" end		9	31	47.
" latitude		40°	1′	12″
assumed	λ''	5h.	1m.	26.8s.
First approximation	λ'	5	1	16.94
2d "	λ	5	1	16.15

Observations of the Solar Eclipse of May 15th, 1836. *Communicated by direction of the American Philosophical Society.*

TO THE COMMITTEE ON PUBLICATIONS.

GENTLEMEN:—By direction of the Amer. Philos. Society, I send you an abstract of the observations of the late solar eclipse, which have been communicated to the Society. It is not complete, some particulars being required which will probably be obtained from the observers, by the committee to whom the observations have been referred, to prepare them for publication in the Society's transactions.

The times of beginning and end are in mean time of the places of observation.

Very respectfully yours,
A. D. BACHE,
One of the Secretaries, Amer. Philos. Soc.

Table of observations of the beginning and end of the solar eclipse of May 15th, 1836, *as observed at Philadelphia, &c.*

Places of Observation.	Time of beginning of Eclipse.	Time of end of Eclipse.	Observers' Name.	REMARKS.
Philadelphia.	h. m. s.	h. m. s.		
1. Hall of Am. Phil. Soc	7 3 45.8	9 32 38.3	Dr. R. M. Patterson,	
2. Dr. McEuen's house,	7 3 38.0	9 32 38.1	Dr. T. McEuen,	2770 feet west of Philos. Hall.
3. "	7 3 50.0	9 32 26.5	Mr. W. H. C. Riggs,	
4. No. 100 S. 8th st.	7 3 40.9	9 32 44.1	Mr. S. C. Walker,	1340 feet west of
5. No. 231 Market st.	7 3 41.0	†9 32 34.0	Mr. Sellers,	Philos. Hall. Teles. 42 inches achrom.
Haverford school,*	7 3 24.5	9 31 47.0	Mr. Jno. Gummere,	Telescope 42 inch. achrom.
Germantown, Pa.	7 3 54.5	9 32 44.5	Mr. Isa. Lukens,	
	7 3 55.5	9 32 49.5	Mr. C. Wistar,	Telescope 3 feet achrom.
Phoenixville, Chest. co.‡	7 3 12.0		Mr. H. Wilson,	
West Hills, L. I.§	7 12 48.5	9 43 40.0	Mr. J. Ferguson,	Large repeating circle of coast survey, used for observations.
Washington City,	6 53 58.0	9 20 08.0	Mr. F. R. Hassler,	

* Assumed lat. 40° 01′ 12″. Long. 5h. 01m. 25s. † Doubtful.
‡ Assumed lat. 40° 08′ 07.″ Lon. deduced by H. Wilson, from eclipse, 5h. 01m. 57s.
§ One of the station points of the coast survey. Lat. 40° 48′ 49.2″. Long. 73° 26′ 12″.

Essays on Meteorology. By JAMES P. ESPY, Mem. Am. Philos. Soc., &c.

No. III.

Examination of Hutton's, Redfield's and Olmsted's Theories.

In the preceding essays many facts independent of theory, have been adduced to prove an upward motion of the air in the region of a cloud, and many more will be adduced hereafter.

At present I propose to examine one of the many phenomena which I hink can be explained by this upward motion only; I mean the great quan-

tities of rain and hail which sometimes fall in a very short time. It was demonstrated in the first part of this essay, that the velocity of the upward vortex, in very favorable circumstances, is 4.5 miles a minute. In rising through that height it will precipitate a little more than one half its vapour, which will be about five inches of rain, so that in this case forty inches would be precipitated in eight minutes, provided it were all to fall in one place, which from the nature of the vortex, can seldom occur. That which is condensed above the point of perpetual congelation, should not be taken into the account; because at the moment of its condensation it becomes snow, and being so light will remain in the atmosphere long after the hail and the rain caused by the melting of the finer masses of hail, in passing down through the lower parts of the atmosphere, have reached the earth. Still there will be enough left to account for the most violent rains or hails, of which we have any account.

Here it may be worth while to turn aside for a moment, to examine the efficiency of the most plausible theory of rain that has ever been given to the world. I mean that of Dr. Hutton. He supposes two currents of air of different temperatures, both nearly saturated with vapour, to be mingled together, and that a precipitation of course takes place, in accordance with the known fact, that at their mean temperature all their vapour cannot be retained, and therefore the surplus will be precipitated. This theory is defective in two respects: First, it does not show how two currents of air could be mingled to any considerable extent; and second, it does not show by calculation, that rain to any considerable amount, would be produced, even if large masses of air at very different temperatures, should be mingled together, which it would be easy to show never can happen, especially in the torrid zone. It may fairly be presumed that no advocate of the Huttonian theory, would suppose that more than 500 feet of a stratum of cold air could be mingled with a stratum of warm air, 500 feet of perpendicular height. Now it will be found by calculation, that if one of these strata is at 60°, and the other at 40° and both saturated previous to their mixture, the whole amount of precipitation, provided they took the mean temperature of 50°, would be less than a grain and one half on each square inch of surface. But as the latent caloric evolved in the condensation of the vapour, would not suffer the mean temperature of the two strata, when mixed to be acquired, but some temperature above 50°, therefore a less quantity than that mentioned, would be precipitated. Such a quantity in most cases, would be entirely evaporated in passing down through the air below, and never reach the earth.

It was mentioned before that 5.1 inches of rain fell in Wilmington, on the 29th of July, 1834, in two and a half hours; let us see whether such a rain could be produced at all, on the Huttonian principles, making the most extravagant allowance for the quantity of air mingled, and also for the difference of temperature of the two strata.

Let us suppose then that one half of the atmosphere at 80° Fah., should be mingled with the other half at zero, over the region round Wilmington, and that 5.1 inches of rain is the result. What will be the temperature of the mingled mass after the rain? The mean temperature is 40°, which would be the temperature after the mixture, if no latent coloric is given out in the condensation of vapour. But from the principles explained before, it will be found, that as five inches of rain, is $\frac{5}{400}$ of the whole atmosphere in weight, the latent caloric given out in the condensation of the vapour forming this rain, will be sufficient to heat the whole compound 59.7°, which be-

ing added to the mean temperature 40°, will make the temperature of the air after the rain 99.7°, almost 20° hotter than the hottest half of the atmosphere before the mixture.

This result, however unexpected, ought not to appear surprising. For if gentlemen will [frame theories on loose principles, without once putting these principles to the test of calculation, and without even taking the least notice of the latent heat of vapour, or the specific heat of air, they ought not to be surprised that a little plain arithmetic should dissipate their empty visions and "leave not a wreck behind."

Theorists will pardon me for this sweeping denunciation, when I now voluntarily come forward and plead guilty to the same charge; for I too have framed a hypothesis to account for rain, and advanced it under the high sounding name of theory.

Having found that the Huttonian theory would not bear the test of calculation, I imagined there was but one other possible mode of condensing vapour and that was that the vapour by its own elasticity in the lower parts of the atmosphere, thrust itself up into a cold stratum above, when ever such a one overlapped the one below, and was thus condensed into rain.

This hypothesis I thought was altogether reasonable from the great discovery of Dalton aud Gay Lussac, that vapour in the atmosphere rests only on vapour, and thus forms an independent atmosphere, and is not supported in the least degree by the air. I imagined then, that vapour could rush with great velocity from air where the due point was high, to air where the dew point was low. But when I discovered that some rains were so great as to be beyond the power of this theory too, I began to suspect the hypothesis itself, which induced me to put it to the following trial.

I united two glass retorts together by their necks, then having covered one with snow, I put ten drops of water into the other and placed it in a vessel of water at the temperature of 130°, and let it remain in that situation seven hours, the temperature of the room during the experiment being about 70°; not one drop was distilled over in all that time.

I then took the retorts apart, leaving open the neck of the one having the water in it; it has continued in the room, open now for thirty days, with a temperature of 70° night and day, and the dew point in the room never as high as 40°, the ten drops of water being now only slightly diminished.

This refutes the hypothesis of rapid permeation of air by vapour, and indeed, proves that vapour, like heat, when it passes up to the upper regions, must be carried by the air, and not thrust up by its own elasticity. But to return from this digression; if the Huttonian theory is unable to produce such a rain as that at Wilmington, what will it do with the one which occurred at Geneva, on the 25th October, 1822, when it rained thirty inches in twenty-four hours; or the one at Jeyeuse, on the 9th October, 1827, when it rained thirty-one inches in twenty-two hours?*

Or how will it account for a storm of hail† which fell in Orkney on the 24th of July, 1818, in the afternoon, nine inches deep in less than nine minutes? And here it may be remarked that this is the storm mentioned before, in which the barometer was observed to fall two inches, near the end of the storm, when it was not nearly so violent as it was in other places. Or how will it account for the immense quantity of rain which fell at Catskill, New York, on the 26th July, 1819?

* Edinburgh Trans. 1823. † Pouillet Eliesmen de Phisique, II. 758.

About half past 5 P. M. a dense black cloud rose up from the S. W. accompanied with a fresh wind, and about the same time, or a little after, a very thick dark cloud rose up rapidly from the N. E. They met immediately over the town; at this instant a powerful rain commenced.

As soon as the clouds met they seemed to fall down on the river over which they met, and then the cloud rested on the water in such a manner that no space could be seen between them. For half an hour there was no appearance of drops of rain, the water appeared to descend in large streams and sheets. In this half hour the quantity fallen was above twelve inches on a level. Two persons testify that some time after the clouds met, they saw at the same moment a water spout rising up from the river nearly opposite, with a broad bottom ascending to the clouds with a whirling motion, in the form of a pretty regular cone.

The whole quantity which fell was more than fifteen inches, over a space of about eighty square miles; and as far as I can collect from the whole account which is given at large in Silliman's Journal, vol. 4, p. 124, this spout was stationary.

The intelligent author of the account, Benj. W. Dwight, says, it is worthy of remark that eleven days before in the P. M., there fell in a shower of short continuance, more than six inches of rain.

This theory has lately been brought forward and extended by Professor Olmsted of Yale College, with a view of accounting more particularly for hail, than the original author of the theory had done. And though I am aware that the strength of my theory does not depend on the weakness of any other, I think it proper to give the Professor's remarks a passing notice.

"We assign," says Mr. Olmsted, "as the cause of hail storms, the congelation of watery vapour of a body of warm and humid air, by its suddenly mixing with an exceedingly cold wind, in the higher regions of the atmosphere. Let us examine, says he, the effects which would result from the meeting of two opposite winds, at the height of 10,000 feet, during the heat of summer, the one blowing from the latitude of 30°, or from the confines of the torrid zone, and the other from the latitude of 50°, or the northern part of British America. If they had equal velocities, they would meet at the parallel of 40°; and, as in the case of the Gulf stream, a fluid does not readily change its temperature, merely by flowing through a body of the same fluid of a different temperature, and especially air through air, each current would retain nearly its original temperature.

The southerly wind blowing from a point which is still 2,000 feet below the line of perpetual congelation, is comparatively warm, while the northern coming from a point 4,000 feet above the same boundary of the empire of frost, will have a degree of cold, probably surpassing any with which we are acquainted. We infer from our preliminary principles, that immediately on meeting, the watery vapour of the warmer would be frozen with an intensity corresponding to the temperature of the colder current; that the minute hail stones thus formed and endued with such excessive cold, would begin to descend, and accumulate to a size proportionate to the intensity of the cold of the nucleus, and to the space through which they descended, and to the humidity of the lower strata of the atmosphere; that is, the colder they were when they began to fall, the farther they fell, and the more humid the air, the larger they would become."

As Professor Olmsted has not shown how these currents could be generated, the theory is plainly incomplete on this ground. And besides, even if they

should be generated, it does not appear how they could be mixed; for either they would meet each other in opposite directions, and so stop each other's motion without mixing to any great extent, or they would slip by one another without much affecting each other's temperature, according to the Professor's own reasoning.

But even if it could be shown that a mixture of two currents could take place suddenly, of even 1,000 feet in perpendicular extent, it has been proved already that under much more favorable circumstances, the dew point being higher, a grain and a half of rain to the square inch would not be precipitated, and that in most cases not a particle of this would reach the ground, for it would be evaporated in its descent, unless the air below should happen to be absolutely saturated with vapour, which seldom occurs.

But, according to Mr. Olmsted, "the minute hail stones being indued with a cold probably surpassing any with which we are acquainted, would begin to descend and accumulate to a size proportioned to the intensity of the cold of the original nucleus."

This remark is erroneous in two respects. First, the cold is certainly not more intense at this great elevation, than one degree for every 100 yards, and is therefore in the northern current only $13\frac{1}{3}°$ below the freezing point; for by supposition it was only 1333 yards above the line of perpetual congelation, when it left latitude 50°.

Second, the original nucleus would not accumulate in the manner described; but on the contrary it would be entirely melted by the time it had descended far enough into the air below the line of perpetual congelation, to have condensed vapour less than one-seventh of its weight. This will easily be perceived by comparing the relative latent heats of vapour and of water, and this too even if it received no heat from the warm air into which it fell. But even if the original nucleus were of the temperature of the interplanetary spaces, 57° or 58° below zero, it would not increase one-fifth in size by condensing on itself the vapour, before it would be entirely melted by the disengaged latent caloric.

Professor Olmsted concludes his essay by saying that the momentum of a hail stone would be one hundred times greater if it did not at every stage of its progress down to the very ground, receive new accessions of watery vapour, which being matter at rest, is to be put in motion by the falling body, and consequently its speed is continually retarded.* But he must now perceive, from what has already been said, that the velocity of descent will not be diminished one-fifth, even when the stone has received an addition of vapour great enough to melt it.

Before I take leave of this extension of Hutton's theory, I must take notice of another remark made by Professor Olmsted, which if correct, would of itself prove fatal to the theory which I have advanced. He says, "we have certain evidence from the concourse of opposite winds, and from the density and consequent blackness of the clouds, that a great condensation takes place in the region of the storm."

Now it appears to me that it would be much easier to account for the concourse of winds, by supposing a rarefaction in the region of the storm, just as the rarefaction in a chimney is the cause of the air in the room moving towards the fire place. It shall be shown hereafter what effect would be produced by a condensation in the region of a storm.

I come now to a most important part of this investigation, the northeast

* Vide Silliman's Journal, vol. 18, p. 1.

storms of the Atlantic states. It is well known since the days of Franklin, that these storms commence in the south west and travel towards the north east with a velocity which varies at different times and places, and that the wind always blows from some eastern point at the commencement of the storm.

Mr. Redfield of New York has collected a great many highly interesting facts connected with these storms, of which some of the most important shall now be detailed.

When a storm commences within the torrid zone it travels west of north until it reaches lat. 30°, when it has become nearly north, it then gradually deflects more and more east of north, until about lat. 40°, it is moving about N. E. That these storms are probably nearly round, varying in diameter, and more slow in their advance along the coast, in proportion to their size, and also slower in low latitudes than in high. That on their north western side, the wind sets in more northerly and changes round during the storm by north, and on the south east side of the storm the wind sets in at the commencement more easterly and south easterly, and changes round by the south.

Mr. Redfield thinks that these facts can only be accounted for on the supposition, that these storms are exhibited in the form of great whirlwinds.

As a more particular proof of this position, he details the facts which occurred in Connecticut, as one of these storms passed there in 1821. He says, "that the mass of atmosphere upon the earth's surface was moving for several hours, apparently towards the N. W. over Middletown, with a probable velocity of seventy-five or one hundred miles per hour, while in the northern parts of Litchfield county, at a distance say of forty miles, the wind, at about the same period, was blowing with nearly equal violence in the opposite direction towards Middletown." Now it will appear by a little reflection, that all these facts agree with the idea of an upward vortex, more consistently than with a horizontal whirlwind.

Indeed I do not hesitate to say, that the last fact is inconsistent with a horizontal whirlwind, and proves with irresistible evidence, the existence of an upward vortex, at least in this storm. For two winds cannot blow towards each other for several hours as here described, without either rising upwards when they meet, or blowing outwards at the sides. But we have proof positive, that they did not blow outwards at the sides, for at N. York, S. W. of the point between Middletown and Litchfield, to which the winds from those places were blowing, the wind changed round by the N. to the N. W., or W. about the time these winds began to blow violently. And we have strong reason to believe that it did not blow outwards to the N. E.; for at the commencement of the storm, through its whole course, the wind always blew from some eastern point.

There is one conclusion which Mr. Redfield draws, which I do not find to be justified by the facts detailed in this storm. "That along the central portion of the track, the storm was violent from the south eastern quarter, *changing suddenly to an opposite direction.*" Now I find, that of fifteen points on the south east side of the storm, at which the wind set in S. of E. only two, Bridgeport, Conn. and one at sea, forty miles north of Cape Henry, are given, as having the wind to change round, even as far as the west. These two, I *suspected* as being contrary to my theory; and upon examination of the newspapers of the day, I find that they report the wind at both these places to have changed round only to the S. W., just as far as it *should* change to satisfy my theory.

All these facts lead to the conclusion, that in this storm, at least the wind in the neighborhood of the storm, blew directly towards its centre, and if so, it follows beyond all doubt, that there was an upward vortex in the middle of the storm. Now as it is impossible to conceive of an upward vortex being formed in the region of the storm, if there is a condensation of air there; so it can only continue on the supposition that the air, as fast as it arrives in the vortex from all sides, becomes rarefied, whatever may be the cause of that rarefaction.

As it has been said that a condensation in the region of the storm would cause an afflux of air there, let us for a moment examine the assertion. Suppose that no latent caloric is given out in the condensation of vapour, and that in a circular space of one hundred miles in diameter, five inches of rain have fallen, the whole condensation which would take place by the change of vapour to water, would be less than a fiftieth of the whole atmosphere, and the air on all sides of the storm, would not have to move one mile towards the centre, before the equlibrium would be restored. Besides it is manifest that this motion could not take place at the surface of the earth, but rather in the region of the cloud and above it. And even if the velocity at the surface of the earth is supposed to be as great as in the region of the cloud, it could not be a mile an hour, for it never has been known to rain five inches an hour in a storm of this magnitude, and the condensation of the air is supposed to take place during the whole rain.

I have myself had the pleasure of seeing and pointing out to many of my friends at various times, particularly to Professor Bache, the clouds moving outwards above, and inwards below, during a summer's thunder gust, which could not be, if there was a condensation of air in the region of the cloud, and I may add without the fear of contradiction, that it proves the reverse. Besides, I have known many instances of long continued and violent rains in the south, during the prevalence of a strong and long continued north wind, and of long continued and violent rains in the north, during the strong and long continued south wind.

An instance of the latter occurred on the 11th, 12th, 13th, 14th, and 15th of May, 1833. In my journal it is stated that a strong south wind prevailed during this whole period night and day. And by consulting the papers of the period, I find the following facts:

Harrisburg, May 16, 1833. When our paper went to press the Susquehanna was sixteen feet above low water mark, and rising—a greater freshet than has taken place for sixteen years—the rain must have been much greater up the river than in the vicinity.

Albany, 15*th*. The most painful accounts begin to be received of the destructive effects of the freshet. The river continued to rise until 10 o'clock this morning, when it was a foot higher than it was in the great freshet occasioned by the ice in the spring. On the 17th, it had fallen only a few inches.

The *Amsterdam* (Mohawk Herald) of the 16th, says, "every bridge and mill dam on the creek near Fort Johnson has been swept away."

Hartford, 18*th*. The water in the Connecticut last evening, was 19½ feet above low water mark.

Montreal, May 15*th*. A larger quantity of rain has fallen here since midnight of last Friday, (five days) than we have had for a considerable period past, and the rain is now falling in torrents, the atmosphere cool and very unpleasant.

The *Goshen* Patriot, says the Delaware rose twelve feet above an ordinary freshet—not a raft above Milford was preserved entire.

These facts afford conclusive evidence that in this case at least, the wind at Philadelphia blew hard for five days, exactly towards one of the greatest rains which our country has ever witnessed. And the statement, that the atmosphere at *Montreal* was cool and very unpleasant, would lead us to suppose that the wind there was coming from some northern quarter; for during this whole period the temperature was very high in Philadelphia, the mean minimum being 65°, and the mean maximum 76°, and if a southern wind prevailed there, it is not at all likely that the air would have been cool and unpleasant.

Again, from the 3d of June, 1835, to the 12th of the same month, the wind was constantly from the north, with one exception from north east, pretty strong for a considerable portion of time.

I find by the *Charleston* Courier, that a dreadful storm of rain set in there on the 3d, and another very violent one on the 8th, which was increasing when the paper went to press on the 9th at 10 P. M., and that on that day there had been no mail from Fayetteville, and that there were six letter mails due from N. Y. and Boston, and five from Washington, Baltimore, and Philadelphia.

All these facts seem utterly at variance with a horizontal whirlwind; and entirely consistent with an upward vortex, if they do not absolutely prove one.

If Mr. Redfield should perceive that all the interesting facts which he has with such laudable industry collected, are fully explained by a theory which accounts also for the rain, I am sure he will not be very tenacious of his horizontal whirlwind; especially when he does not pretend to show that either the whirlwind is the cause of the rain, or the rain the cause of the whirlwind. Let us, however, examine for a moment (for I should be proud to enlist Mr. Redfield under the banners of a true theory) what would be the phenomena, on the supposition that there is a horizontai whirlwind, say of one hundred miles in diameter, moving with a velocity of seventy-five miles an hour, or 110 feet per second. It is demonstrated in mechanics that if a body moves in a circle, with a radius of sixteen feet, and a velocity of sixteen feet per second, its centrifugal force will be equal to its gravity. And as centrifugal force is directly as the square of the velocity, and inversely as the radius, the centrifugal force of the air in this whirlwind is ascertained by the following proportion:

$$\frac{16^2}{16} : 1 \text{ (gravity)} :: \frac{110^2}{25 \times 5280} : \frac{1}{74} \text{ or } \tfrac{1}{74}\text{th part of the gravity.}$$

And as a wedge of air fifty miles long is about eight times as heavy as a column of atmosphere equal to its base, its whole centrifugal force will be $8 \times \frac{1}{74}$ of fifteen pounds to the square inch, which would cause the barometer to rise about $1\frac{4}{10}$ of an inch in the borders of the storm, both at its commencement and termination; and cause a motion of the air outwards due to this pressure, which would be about 280 feet per second, according to the principles established in a previous part of this essay. Now these two phenomena are entirely wanting in all N. E. storms; for the air does not blow outwards from the storm, nor does the barometer rise at the termination above the mean, though it sometimes does at the commencement, for a reason which shall hereafter be explained. Besides, if such a whirlwind could be generated, it is manifest that it would soon be destroyed by its

outward motion, unless some mighty cause exists, of which we have no knowledge, to generate new motion in the air, which would descend from the upper regions of the atmosphere in the middle of the whirlwind, to take the place of that which had thrust itself out by its centrifugal force. It may be added, that the readiness and ease with which the air would descend in this whirlwind, would be so great that the rarefaction of the air in the inside, caused by the centrifugal force of the air would be a quantity very minute, unless we suppose the whirlwind to reach to a great height, which cannot be the case, if it is produced by friction on the West India Islands, and on our coast, as is alleged.

Therefore, it will not account for the great fall which is known to take place in the barometer, during these violent storms, a fact which is fully explained by the theory here proposed. Besides, Mr. Redfield need not be told that this downward motion of the air in the centre of the whirlwind, would increase its capacity for vapour, and effectually prevent deposition.

Bibliographical Notices.

Concise decimal tables for facilitating Arithmetical calculations, &c., designed for practical men. By Timothy Claxton, Boston. *Published by the author.**

A sheet containing one of the most concise series of tables which we have ever seen, for facilitating arithmetical operations, has been published by the author, Mr. T. Claxton of Boston. It is accompanied by a pamphlet explanatory of the tables, and containing also an exposition of the system of decimal fractions, a list of data from which the tables are compiled, and an index to them.

The tables may be classed as mathematical, mechanical and miscellaneous. The former contain tables for finding the circumferences and areas of circles from their diameters, the diameters from the circumferences, and square roots of the areas, the side of a square equal in area to a circle from the diameter or circumference given, &c., the solidity of a cone from the square of the diameter of its base, and its height, and a sphere from its diameter, &c. &c. Among the mechanical tables are a series for the reduction of weights and measures, for calculating the weights of solid and hollow cylinders of cast-iron, the weight of square and round bars of iron, of spheres of cast-iron, lead, &c. all from convenient data. Among the miscellaneous tables, are those for reducing sterling money to dollars, or vice-versa, the amount of rent or salary for any number of days, having the annual amount &c. &c. There are in all, forty-eight tables conveniently arranged upon a sheet of 10 by 13 inches which may be hung up in the counting-house, or folded for the pocket, for reference.

These tables recommend themselves highly for convenience, and as far as we have examined the calculations we have found them correct. B.

* The Franklin Institute owe to the liberality of the author a number of copies of these tables, which he has requested may be distributed among the members. His object in the publication, is the dissemination of what he justly conceives to be useful matter. Com. Pub.

The Steam Engine familiarly explained, with a historical sketch, &c., by the Rev. Dionysius Lardner, *with additions and notes by* James Renwick, L. L. D., *Prof. of Nat. Exper. Philos. and Chem. Columbia College, N. Y.* Second American from the fifth London edition. Philadelphia, Carey and Hart, 1836.

This is a new editon of *Lardner on the steam engine*, presented in an enlarged form, and with considerable improvement in both the matter, and the manner of getting up the work.

The principal additions consist of a view of steam navigation, a description of important points connected with the economy of steam power, and compendious maxims for the guidance of those engaged in rail-way enterprises. Besides these, there are minor additions and improvements. We have often heard it urged by practical men, that they have been disappointed in the information given by Lardner, in the former editions of this work. This was plainly because they expected to get from the book information which it was not intended to give. It is not intended to furnish a practical discussion of the steam engine, either stationary, as applied to navigation, or to locomotion on common roads and rail-ways; of course the reader who consults it for such a purpose, must experience disappointment. But the general reader, or the student who wishes to obtain a correct idea of the principles of the steam engine in its various applications, will be gratified by the lucid descriptions, the happy arrangement and manner of the author, the easy style with which the subject flows; and will find when this work has been carefully read, if he wishes to go deeper into the subject, that he can consult more profound treatises, with many fold the advantage which he would have derived, without this previous preparation. This is of course not the place for a particular review of the minutiæ of the work, but in conclusion, we may add, that we consider it as materially increased in value, by the general accuracy of the American edition, which is guaranteed by the name of Professor Renwick. B.

Franklin Institute.

Monthly Conversation Meeting.

The Ninth Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 26th of May.

Mr. Chas. F. Voorhies, of Philadelphia, exhibited a portable printing press of very compact form, designed for card printing and other light work.

Mr. Allen Ward, explained the principles upon which he constructs his scales of equal parts, for the use of tailors, and exhibited several diagrams illustrative of the method of adapting the scale to the peculiarities of shape. and the variation of fashion. Mr. W. has been very successful in reducing to mathematical precision, this intricate art.

Committee on Science and the Arts.

Report on Mr. Amasa Holcomb's Reflecting Telescope.

The Committee on Science and the Arts, constituted by the Franklin Institute of th

State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Reflecting Telescope, invented by Mr. Amasa Holcomb, Southwick, Massachusetts, REPORT:—

That the following description of the instrument, submitted to the Committee, is given by Mr. Holcomb, viz:

"It is of the reflecting kind, having the front view, and has a focal length of about nine and a half feet, and an aperture of eight and a half inches. It has six eye pieces, of powers from ninety to nine hundred and sixty."

The evenings of the 22d and 23d of April, proving unfavorable, a third trial was made on a following night, when the performance of the instrument was very satisfactory. It is of the same size as the largest submitted last year. The mechanical execution of the mounting is quite superior, and leaves little to be desired, whether we regard steadiness, convenience in command of the instrument, or facility of finding objects.

The committee do not hesitate to pronounce this instrument superior in performance to any that have yet been exhibited by Mr. Holcomb.

The ring of Saturn was seen to be double by all the members of the committee present, the dark space between the rings could be observed on each ansa, half way to the conjugate axis of the perspective ellipse, under which it was viewed.

ζ Bootis which last year was so far separated that the discs became tangent to each other, presented the same appearance this year, with a power of 250. But with a power of 960 the dark space between the stars was equal to one-fourth of the disc of either.

In ζ Cancri, the close pair, distant about $1''.1$, were so far separated that the dark space was visible as a line between them. This was considered too difficult for either of the telescopes exhibited last year.

A power of 960 was used in examining γ Virginis. This remarkable pair, of which the distance is $0''.8$, according to Herschel's ephemeris, or $0''.6$, according to Struve's late measurements, gave no indications of being double.

This instrument was made to order for John A. Fulton, Esq. of Chilicothe, Ohio, a gentleman whose liberal encouragement of this department of the arts is worthy of all commendation. While, however, the committee would applaud the patriotism of those individuals, or corporate bodies, who encourage American artists, they cannot but remark, that should the course of Mr. Holcomb be suddenly arrested, and the manufacture of these instruments cease in this country, their place could hardly be supplied by importation, at three times their present cost.

The four or five choice instruments made by Mr. Holcomb, have been the result of twice as many years of labour and perseverence, for which no adequate compensation can have been expected, except that satisfaction which every lover of science feels, in improving and extending the means by which it may be pursued.

The committee have little doubt that under proper auspices, and at an expense not exceeding that already encountered by some of our corporate institutions, in procuring instruments of little use, a twenty foot telescope might be made, which should do honour at once to the artist and the country.

By order of the committee.

March 11, 1836. WILLIAM HAMILTON, *Actuary.*

Mr. C. Wesener's manufacture of Artificial Soda.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. C. Wesener's manufacture of Artificial Soda, REPORT:—

That they have examined the various samples of artificial soda laid before them, and after a careful comparison of them with different specimens of Barilla, from Teneriffe and Sicily, are of opinion that these products may advantageously supply the place of the imported salts, for most purposes in the arts, as from a comparative trial made by means of the alkalimeter of Duscroizilles, it was satisfactorily shown that the proportion of soda in the several qualities manufactured by Mr. Wesener, rather exceeded that contained in natural barilla of about the same market price. There is, it should be stated, no novelty in the manufacture of this article, except that it is procured from the sulphate of soda, left as a residue in the making of nitric acid, from the native nitrate of soda from Peru, instead of from the same sulphate left after the extrication of muriatic acid from common salt; the artificial soda made from the last mentioned residue, almost always contains some chlorine, from which it is difficult to free it, whilst that made by the process of Mr. Wesener, is wholly free from this body.

The great consumption of the inferior qualities of soda, is by the soap makers, who are in the habit of using the natural barillas in preference to the artificial, from an idea that they are better and give out less sulphuretted hydrogen; the presence of this offensive gas, although of no consequence as regards the quality of the soap, is a serious evil where the manufacture of soap is carried on in a city, as is the case with most of our establishments of this kind. Mr. Wesener, has however, obviated this, by the preparation of an article which can be afforded at about the same price as natural barilla, and containing 62° of soda, which is entirely free from hydro sulphuric acid, and which hence can be employed by the soap boiler, without creating the nuisance usually attended on the lixiviation of the salts used by him.

By order of the committee.

May 12, 1836. William Hamilton, *Actuary.*

Report on Mr. Charles Potts's Pumps for Steam Engines.

The Committee on Science and the Arts, constituted by the Franklin Institute the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, a Pump for Steam Engines, invented by Mr. Charles Potts, of Philadelphia, REPORT:—

That the inventor proposes (for the purpose of supplying the water to steam boilers) to employ, in lieu of the ordinary forcing pump, a contrivance by which the water runs into the boiler by its own gravity. It consists of a chamber, or cavity, connected with the boiler below, and a tank or reservoir above it, and communicating with them alternately, first filling with water from the tank and then emptying it into the boiler, into which it passes by its own gravity in exchange for an equal bulk of steam.

In regard to the important question of novelty, the committee have to state that the proposed plan is familiar to them, but it is considered to be of doubtful utility, as the chamber must be below the temperature of boiling water at the time of filling, and again raised, at least in part, to that of the

steam in the boiler, before it can be made to descend into the boiler. They consider, however, that the apparatus is worthy of a renewed trial.

By order of the committee,

May 12, 1836. William Hamilton, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN JANUARY, 1836.

With Remarks and Exemplifications by the Editor.

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1. For *Water proof Silk Plush Hats;* George Blake Dexter, Boston, Massachusetts, January 6.

This patent is taken for what is deemed an improvement in the manipulation of applying the silk plush to the body of the hat, after it has received the ordinary coating of dissolved caoutchouc, by which it is made to adhere; the process consists mainly, in passing a metallic cylinder over the plush so as to press it against the body of the hat, and cause it to adhere to it. This cylinder is, we apprehend, formed by bending a metallic plate so that its ends shall nearly meet, and around this a band of India rubber is to be placed, which by its elasticity, is to keep the metal in close contact with the crown. The description is not very clear, but such is our understanding of the thing. The claim is to "the improvement in the application of plush or any other fabric to the body of the hat, by means of a bent metal plate, and by an operation as above described."

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2. For an *Elastic revolving belt Saw;* Benjamin Barker, Ellsworth, Hancock county, Maine, January 6.

The patentee says, " what I claim as my invention, and not previously known in the above described machine is, the elastic revolving belt saw, and the manner of using the same. I do not therefore, claim as my invention any of the other several parts of said machine, nor their particular combination." If the patentee could have made any new arrangement of the parts for operating this saw, he might have claimed such arrangement with some propriety, but the saw itself which he does claim is quite an old affair; it is mentioned in Rees' Cyclopædia; has previously been patented more than once in the United States; has been repeatedly tried, and as frequently abandoned as worthless in operation; and such will again be its fate, should it again be essayed by the present patentee.

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3. For a *Forest, or Tree Saw;* Walter Hunt, city of New York, January 6.

Considerable ingenuity has been displayed in the arrangement of the apparatus described and figured by the patentee, who has made his invention fully known. The apparatus consists of a *grapple* by which the whole is to be attached to the tree to be felled, by means of a screw, spike, &c.; the *lever*, to which one end of the saw is to be attached, and which, by being moved backward and forward horizontally, operates on the saw; the *saw* and a *spiral spring* by which the latter is to be kept up to its cutting bearing,

The particular construction of these parts we shall not attempt to describe. The patentee claims "the style of construction, combination, and arrangement of the *forest tree saw*, as above specified, &c." We shall not, as we have said, attempt a particular description of the proposed arrangement of the parts of this machine, but predict that it will share the fate of other saw machines for felling trees, and be found by far less efficient than the axe of the woodman. We apprehend that the patentee has not had much experience in clearing land, or he would have known that his wedges and other contrivances would not enable him to determine the direction in which his tree should fall, and that the experienced axeman is sometimes at a fault in this particular, an event which would be fatal to the whole apparatus before us.

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4. For *Separating foreign seeds from Clover Seed;* James Manning, Lambertsville, Hunterdon county, New Jersey, January 6.

A screen, or riddle, is to be made in the form of a flour bolt, or otherwise, and this is to be covered with wove wire, the meshes of which are oblong, and a little narrower than the diameter of the clover seed; the claim is to the "making these apertures of an oblong figure." This patent will take rank with those which are the least worthy of an exclusive right, for however good such a screen, sieve, or riddle, may be, it has been so common as to render the idea of claiming it as a novelty truly ridiculous.

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5. For a *Washing Machine;* Joab H. Hubbard, Bloomfield, Harford county, Connecticut, January 6.

By this machine the clothes are to be "pounded" in a box, upon the bottom of which there are pins projecting upwards; the pounders, two in number, having pins on their lower sides which pass into the spaces between those within the box. The pounders have each a rod extending up from them through the lid of the box, and these being operated upon by cams and springs, are raised by the former and forced down by the latter. A horizontal shaft carrying a cog wheel, and turned by a winch, causes a second shaft, having a pinion on it, to revolve, this latter, carrying the cams, or lifters—rather a complicated child of ingenuity this, and one, which we opine, will not find many foster mothers.

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6. For a *Machine for cutting Wooden Screws;* Joseph Peavy, Levant, Penobscot county, Maine, January 6.

This machine for cutting male and female screws upon wood, differs so little from others which have been used for that purpose in large manufactories, as not to require any particular description. The V is fixed upon a sliding frame, the piece to be cut being contained in another frame, in which it is made to revolve by turning the guide screw, which at the same time forces the V frame forward. A similar apparatus, with a suitable cutter, is used for the female screw.

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7. For *Dyeing and colouring Hats;* Aaron Gould, Washington, Litchfield county, Connecticut, January 6.

The hats are to be put into a basket, or crib, and this placed in the dye kettle, and taken out for airing in any way that may be preferred, until the colour becomes perfect. This is all, but is it new?

8. For an improvement in *Locks for Doors;* Solomon Andrews, city of Perth Amboy, New Jersey, January 11.

In this lock, which is intended chiefly for large doors, the cam part of the key consists of several pieces which are passed on to the shank, and being of different lengths, may be variously combined, thus admitting of numerous changes by corresponding changes in the tumblers upon which the cams of the key are to operate.

There are eight distinct claims made to the different parts of this lock, which, however, would not be understood, if given without the drawings and description. In the general mode of combination and action by means of movable cams and tumblers, it bears considerable resemblance to the lock patented by Mr. Kyle, described in vol. 10, p. 331.

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9. For a *Mill for cutting Grain and other articles;* William Gerrish, Portsmouth, New Hampshire, January 11.

Two iron plates from six to eighteen inches in diameter, constitute the cutting, or grinding, part of this mill. The under plate is to be the runner and to be driven by any proper gearing; both plates are to be slightly conical. The upper plate is to have several perforations in it, which are to receive cutting irons, fixed and operating in the manner of plane irons. Besides these cutters there are ridges, or teeth upon the grinding faces. The claim is to "the cutters and cavities, their particular arrangements and principle, applied to this purpose."

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10. For *Building Wharves, Piers, &c.;* John G. Pray, Brooklin, King's county, N. York, January 11.

The building of wharves, piers, and breakwaters, is treated in this specification, as a very simple and easy affair, but it certainly is not rendered so by the clearness of the description, or by any references to the drawing; the former being extremely general in its terms, and the latter, although well enough executed, showing a wharf in its finished state, and without any references whatever; nor is there any claim made to any part of the invention.

After the foundation has been laid, "which is done with the greatest ease, blocks, piers, or pillars of any dimensions, may be raised thereon in the following manner," &c. &c. We are to take blocks of stone, or of cast-iron, eight or ten feet long, and one or two feet square, and provide two of them with a *conductor* at each end, one or two inches in diameter, so placed that when the stone is laid for the foundations, the conductors will rise above the water, down these the stones, or blocks of iron are to be slid, they being, we suppose, drilled with holes through them for that purpose. The stones, &c. are to be piled up in this way, the second laying transversely upon the first. The ends having been prepared so that they will come together in a dovetail. When raised to a sufficient height they are to be arched over. We think any thing further unnecessary, the foregoing being a fair example of the mode of description adopted in this specification.

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11. For *Dressing and Napping Cloth;* Stephen Marsh, Jerico, Chittenden county, Vermont January 11.

This machine in its general construction, resembles those now in common use for the napping of cloth, but the patentee thinks that considerable advantage is derived from causing the card teeth on the napping cylinder to

stand in the direction of radii, or nearly so, from its centre. "Said Stephen Marsh, claims as his invention, the direction of the card teeth, radiating in direct lines from the centre, or axis of the cylinder, or having a less inclination than those which are now, or heretofore have been, in use. Also the passing the pivot of one wheel through the axis of rotation of the other, and the general arrangement and combination of the machinery as set forth." We doubt the validity of the claim to the radiating, or nearly radiating, teeth, as we believe that they have been frequently so employed. The other point claimed is a mere matter of arrangement, not at all necessary to the action of the machine.

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12. For a *Machine for Drilling Wood, Metal and Stone;* William Roy Jones, Granville, Washington county, New York, January 11.

If this be an improvement in the mode of drilling and boring, we should prefer some unimproved machinery that we have seen in use. A frame is made, having a bed upon which to place the frame to be drilled or bored; the drill is fixed in the lower end of a vertical shaft, or mandrel, which is to be turned by a winch on its upper end. The mandrel passes through the centre of a wooden, or metallic, screw, turning in a nut in the upper part of the frame, which screw is to be forced down by a handle on its upper end, just below the above named winch. The claims "are to the crank (winch) on the end of the screw passing through the nut, and the screw pressing on the shoulder of the mandrel."

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13. For *Hanging Carriages by means of tubes and spiral springs;* Henry Mellish, Walpole, Cheshire county, New Hampshire, January 11.

"The invention here claimed is the combined application of the springs and tubes to the above named purpose." The contrivance consists simply of a spiral spring of wire enclosed in a tube, with such appendages as are necessary to attach it to the carriage, and to cause the weight of the body to rest upon the springs. There is no novelty whatever in the employment of spiral springs, contained within tubes, for hanging carriage bodies, but they have been found so much less to be depended upon than springs of the more ordinary kind, that they have uniformly, after trial, been thrown aside.

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14. For a *Machine for Planting Corn;* Charles R. Belt, Washington county, District of Columbia, January 15.

There are many patented machines for planting corn, cotton, and other seeds, so nearly resembling each other, as to constitute different modifications only of the same machine, and such is the character of the one before us. The claims made are confined to two particular points in which the patentee considers his machine as excelling its predecessors, but its superiority not being apparent to us, we shall pass on to other matters.

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15. For a *Plough;* John Dolhaner, Canton, Stark county, Ohio, January 15.

There is nothing claimed as new in this plough, but the mode in which the parts are fastened together, so as to give it the desired stability.

16. For an improvement in the *Construction of Bedsteads;* Jonas Maguire, city of Philadelphia, January 15.

Dowells are to be put into the ends of the rails instead of cutting tenons thereon, and corresponding holes are to be bored into the posts to receive the ends of these pins, or dowels; screws are to be used for fastenings, in the usual way.

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17. For *securing Wells from the influx of Surface Water;* Levi Kidder, city of New York, January 15.

"The principle of this improvement consists in the construction of hydraulic cement, of a protecting cover and sides to wells, cisterns, reservoirs, and other vessels in the earth, whereby the water within them will be secured against the influx of surface water, and the intrusion of vermin in the mode and by the means substantially as described."

The mode described is to raise a wall of cement upon the ordinary wall of the well, to cover this with a top in the form of a dome, leaving an opening in the middle for the pump body.

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18. For the application of hydraulic cement to making *Covers for Wells, &c.;* Livi Kidder, city of New York, January 15.

This patent is taken for covers pretty much like those above described; that is to say, a cover for wells, cisterns, &c. is to be made in the form of a dome, leaving a suitable opening for a man to pass through, or for other purposes; it appears, however, that the design is to secure the particular mode of forming such covers, which is as follows:

A mound of earth is made in the shape of the inside of the cover, and upon this mound the cement is to be cast, or spread, to the thickness of four inches, more or less. When the cover is large, it is to be divided into sections of a convenient size for removal. "The improvement which this applicant claims to have invented, consists in making said covers, not upon the well, cistern, or other vessel, where they are to be used, but in a shop or suitable manufactory in which they can have time to season, and from which they can afterwards be removed to the place of use."

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19. For a *Machine for pressing Tobacco in;* J. Beverly Allen, city of Richmond, Virginia, January 15.

This machine for pressing tobacco in, is merely a square box, four of the sides of which are of tin, the other two being of wood. The patentee says that "before this box was invented the manufacturers of pressed tobacco were compelled to use oaken boxes, the material for constructing which has recently become very costly. and difficult to be obtained. What I claim as my invention, and not previously known, in the above described machine, is the use of tin for four sides thereof, instead of wood, which was before exclusively used."

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20. For an improvement in the *Machinery for forming and hardening Ropes, of any required length;* John Whiteman, city of Philadelphia, January 15. (See Specification.)

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21. For an improvement in *Trunks, Valises, &c.;* James W. Noble, Pittsfield, Berkshire county, Massachusetts, January 15.

There is not any thing furnished by the patentee which amounts to a de-

scription of his mode of making trunks, valises, &c.; we gather, however, from what is said, that there is to be a frame, to which the leather used, is to be attached by means of rivets, without the use of sewing, or of tacks. The frame, we suppose, must be of iron, perforated so as to receive the rivets; but even this is matter of conjecture; yet, if the story told be correct, the improvement is worthy of a good specification, as we are informed that this trunk, &c. will possess great strength, and compactness, require less leather than ordinary in the construction, and produce a saving of seven-eighths of the time ordinarily consumed in the manufacturing of such articles.

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22. For a *Plough;* Samuel Witheron, Gettysburg, Adams county, Pennsylvania, January 15.

The whole description is as follows: "The improvement consists in placing a roller under the beam, near the centre of the plough, in or near a perpendicular position; the roller may be made plain, ridged, grooved, or otherwise. The use of the roller is to prevent the plough from choaking, by rolling off the vegetable matter that usually collects under the beam."

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23. For an *Art, or method, or process, of lessening the consumption, and of increasing and otherwise improving the effects of fuel;* Isaac Orr, Washington, District of Columbia, January 20.

It is not easy from the title, to tell for what this patent has been obtained; whether for a stove of a particular construction, or for the art of managing the fuel. The claims, however, fifteen in number, relate principally to matters of construction, but in a way so general and diffusive, as not by any means to enable us to distinguish those things which are intended to be the subject of the patent "from all other things before known or used," as required by the act of Congress. The principal feature in the stove which the patentee denominates the *air-tight stove*, is the so constructing,or making, the sliding or other doors which open into the stove, that when closed they shall be, as nearly as may be, air-tight, by which means the combustion of the contained fuel, may be completely controlled, and but little, or no, consumption take place, whatever may be the quantity within the stove. That such a stove cannot, and must not, be made perfectly air-tight, will be at once admitted, and we are not aware at what degree of good fitting, the affair would be entitled to a patent. We have a stove in which the design was to make the doors, and the ash drawer, fit as closely as possible, so that the fire might be regulated by the drawing out, or closing, of the latter; this is one of Spoor's, and there are many others similarly constructed in this respect, and in which, were the workmanship made a little more perfect, without any change of structure, all that Mr. Orr proposes from this arrangement would be accomplished.

In addition to the close doors, the patentee has grate bars placed under the fuel, resembling the revolving vertical dampers, or valves, used in some stoves, and consisting of two plates with openings, which may be made to coincide, or which may be closed by the unperforated parts. If we do not greatly err, such a grate will be obstructed by the coal, and choaked by the ashes. There may be enough in some of the individual arrangements pointed out, upon which to found and sustain a claim, but they are not made to stand alone, and it is not in our power to put them in a situation to do so.

24. For a *Portable Reflecting Baker;* Lorenzo B. Olmstead, Binghampton, Broom county, New York, January 20.

This tin baker is to be heated by means of a cylinder of sheet-iron, which is to contain ignited charcoal, and to pass vertically down through the back of the box which constitutes the baker. This latter is a kind of eight sided oven, the top being ridged like a roof, and the bottom in the same form inverted, the back circular, and the front, which lifts off, being straight; we mention these things because the peculiar form is claimed. The articles to be baked are put into pans, which stand on wires within the baker, and the fire being kindled, and the front reflector affixed in its place, we are assured that the desired operation will be "performed sooner than in any known oven or baker, with an immense saving of fuel."

25. For *Cutting grooves in Corset rings of Bone, Ivory, &c., and also in other articles;* Charles Buckland, Middletown, Middlesex county, Connecticut, January 20.

The ring to be cut is placed upon the projecting end of a revolving mandrel, the frame of which is made to slide so that the ring may be brought up against a revolving saw, or cutter, which cuts the groove. The appendages for adapting it to the purpose to which it is applied, are represented and described, and the combination of the several parts constitutes the claim.

26. For a *Thrashing Machine;* Eleazer Brown, Chenango, Broom county, New York, January 20.

This thrashing machine consists of a hollow cylinder about three feet in diameter; its length is not mentioned, but from the drawing, we should suppose it to be, at least, twelve feet. It stands horizontally in a frame, and within it revolves a shaft, which carries four, or any other number of rows of wooden beaters. The grain is fed into the cylinder through an opening in its side, near to one end, which is closed, the other being left open. On the shaft near the closed end are spiral fan leaves, which force a current of air through the cylinder. The patentee says that "the rapid motion of the shaft separates the grain, and the strong current of air driven through the cylinder by the fans, carries out the straw and grain." There is no claim made, the general construction being probably considered as new, which we believe it is.

27. For a *Horse Power;* Samuel Newton, Dayton, Montgomery county, Ohio, January 20.

This horse power is one of that kind which receives its impulse from the walking of the horse, or other animal, upon an inclined floor forming a chain of slats, the patentee calls it the "Friction Obviator, or Double Chain Horse Power," in which is combined the joint application of two continuous, or endless, chains. The second of these endless chains consists of rollers connected by suitable straps, which sustain the movable floor by running upon a suitable railway under it, the part not so employed hanging down beneath the floor. After a full description of the apparatus a claim is made to "the particular manner of constructing the friction chain," &c. We could refer to several patents taken in the United States, for a perfectly similar contrivance, but will go farther back than any of these, and look in the second volume of the first series of the Repertory of Arts, p. 366,

where we find the same machine described and figured, having been patented in England, in January, 1795.

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28. For *Propelling Boats;* Philander Noble, Westfield, Hampden county, Massachusetts, January 20.

The patentee is, we apprehend, either a clock or watch maker, and knows very well that a spiral spring contained in a barrel, and made to act upon a fusee by means of a chain, is a sufficient maintaining power for his time keepers, and, by parity of reasoning, he concludes that it will answer equally well for boats. "This invention or improvement, consists in the application of the machinery of a clock to the purpose contemplated." The springs, we are informed, are to be wound up in the usual way; by means of the finger and thumb, we suppose. The plan is too absurd to reason about, and too contemptible even for ridicule.

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29. For a *Plough;* John P. Chandler and Peter Ranger, Wilton, Kennebec, Maine, January 20.

We have, for brevity's sake, called this a plough, but the patentees denominates it a "Machine for ploughing land," and indeed from its complexity it appears to require some such appellation. It has an axletree and two wheels, like a cart, with a frame somewhat like that of a cart body, sustaining a tongue to which to attach the horses, together with other appendages. Under this frame there are to be three ploughs abreast, all of which are to be managed, by means of levers and suspending chains, by a person seated on the machine; the ploughs being so suspended that they can be raised or lowered at pleasure. The claim made is to "the using of two or more ploughs at the same time, and with the same team; and also having the plough suspended so as to have the weight of it carried on wheels." The patentees might, probably, sustain a claim to their own mode of doing these things, but double ploughs have often been used, and wheeled ploughs are represented in the books, and are common in Europe.

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30. For an improvement in *Saddles and Horse Collars;* Ebenezer Hale, city of New York, January 20. (See Specification.)

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31. For a *Corn Sheller;* Warren Carpenter, New Castle, Mercer county, Pennsylvania, January 23.

A plank is to be slid up and down between two cheeks, grooved for that purpose; into each side of this plank iron pins are driven, which project out a short distance. The corn to be shelled is to be dropped in between this slide, and two pieces of plank near the lower end of the frame, which are borne up towards the slides by springs; these spring pieces of plank are armed with teeth, like the slide. The slide is to worked up and down by hand. The claim made is to "the particular structure, combination and arrangement of the respective parts."

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32. For a *Forcing Pump;* Benjamin Egbert, Lansing, Tompkins county, New York, January 23.

There is about as little to patent in this pump, as in most of those which obtain that nominal sanction. The claims made are to things either old, or worthless, and the whole construction is as far from meriting the name of an improvement, as can well be imagined. The claims made are to "the

base plate, the forked tube, the side rods, the cap piece, and the waste tubes, together with the mode of fastening the pump by the platform to the sink." The patentee might with about equal propriety claim his shoes, his two arms, his legs, his fur-cap, and his facial protuberence, together with the mode in which he seats himself at the table.

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33. For a *Cast metallic Funnel, to be used on Stove Pipes;* Ezra Ripley, city of Albany, New York, January 23.

Ferules are to be cast which pass into, or receive the ends of the pipe to be joined. These ferules are to be made ornamental, and there is a contrivance for attaching them to the pipe, by means of a wire, so as to keep them together. These ferules, the patentee says, "improve the beauty, increase the heat, and add strength and security."

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34. For an *Expanding Sulky Seat;* Orion H. Capron and Gardner Barton, Jr., Shaftsbury, Bennington county, Vermont, January 23.

The body of the sulky is to be made so that the seat and back shall consist of slats, or rods, which may slide between each other, so that it may lengthen out and accommodate two persons. The cushions must, of course, be made so as to double when the vehicle is in the sulky mood. The construction of the affair is described, but the mode of procedure is not claimed.

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35. For a *Machine for Packing Flour in Barrels;* Jonathan F. Barrett, Granville, Washington county, New York, January 23.

This is certainly a new, and, we think, a good machine. The flour to be pressed, runs into the barrel in a continuous stream, and the pressing commences at the bottom, and goes on until the barrel is filled. The barrel is placed on the bed of the press, and above it there is a vertical shaft, which is made to revolve by a drum and band, and is capable of rising and falling through the height of the barrel At the lower end of this shaft there is what is called a screw, but this essential part is very imperfectly described; it is nearly of the diameter of the interior of the barrel, and appears to be a transverse section, containing a single thread of a screw, and it has, of course, an opening from its upper to its lower side, through which flour may pass. The shaft, we suppose, must revolve in a direction tending to raise this section of a screw, and the bottom of it, forming a spiral inclined plane, presses upon the flour as it passes through the opening, having to operate upon thin successive strata only, and thus gradually rising to the top, when the packing is completed. The shaft is loaded with any amount of weight which may be found necessary, and there is appended to it the apparatus necessary for raising and lowering the shaft rapidly, when requisite. The claim made is to the employment of "a screw on the end of a weighted shaft," in the manner described.

The patentee says that about three minutes completes the pressing of a barrel of flour; the manual labour, however, not exceeding five seconds; that during the operation there is not any bursting of hoops, or pressing of flour out of the sides; that with a machine made to test the improvement, one man can readily pack, weigh, and nail off, about twenty barrels per hour.

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36. For an improvement in the *Construction of Wooden Bridges;* Stephen H. Long, Lieut. Col. U. S. Topographical Engineer Corps, January 23.

"The improvements claimed as new and useful consist in the application

and use of lattice, work, in the manner and of the description herein explained, for the purpose of imparting the requisite lateral stiffness to wooden bridges, in a manner more simple, economical and efficient than the means heretofore employed for that purpose; it being understood that *lateral* and *horizontal* stiffness, in contradistinction from *vertical* and *transverse* flexibilty, is the object of this invention."

This diagonal lattice-work framing, to be applied to the upper, or the lower, string pieces of bridges, is similar to the lattice-work truss frame, forming the sides of Town's bridges.

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37. For an improvement in the *Garden Hoe;* Adna Allen, Ramapo, Rockland county, New York, January 23.

This patent is taken for the manner of attaching the shank to the plate of the hoe, so as to render it secure from working loose. The plate or blade of the hoe, is perforated with a square hole; the shank is made to fit this hole, and has a collar formed on it which comes up against the plate; a second plate, like a washer, passes over the shank on the face of the hoe, and the whole is secured together by riveting; the shank is secured in the handle by a ferule, and fastened by a key driven through both. The claim is to "the collared shank, back plate, and rivets, viz: the collar on the shank, and the principle of attaching the back plate to the plate of the hoe."

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38. For a *Trap for Rats and other Animals;* Thomas Neil, Kirkersville, Licking county, Ohio, January 23.

This trap is so much like some others, that the claim to "the before described machine" appears to us to be a claim to that which had been made, if not described, long before. The trap is a long box, with a fall at each end, held up by a trigger very much like other triggers. In the centre of the box are placed two pieces of looking glass, to invite tenants to enter; an old and well known device.

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39. For *Constructing Coffins of Hydraulic Cement;* John White, Syracuse, Onondaga county, New York, January 23.

"The patentee says, "all that I claim under the foregoing specification, and wish to secure by letters patent, is the right of employing any hydraulic cements, materials, or mortars, not included in the before mentioned patents, in the making of receptacles for the dead; constructing the same in any form or shape which may be deemed convenient or desirable."

The "before mentioned patents" above referred to, are that granted Dayton, Hoyt, and White, on the 6th of June, 1835, and that to John White alone, on the 25th of July, 1835.

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40. For an improvement in the *Horse Collar;* John Hopkinson, Hamilton, Warren county, Ohio, January 23.

The specification tells how to make a patern by which to cut the leather, how to soak it and to tack it on to a cramping board, how to sew the parts together, and concludes by giving advice to stuff it, make the pad, and finish it off in the usual way; but it says nothing about a claim. There is a drawing, from which we cannot learn any thing, excepting that it represents a well looking horse collar.

Specifications of American Patents.

Specification of a patent for an improvement in the manner of constructing Saddles and Horse Collars. Granted to Ebenezer Hale, *City of New York, January 20th,* 1836.

To all whom it may concern, be it known, that I, Ebenezer Hale, of the city, county and state of New York, have invented a new and useful improvement in the manner of constructing saddles and horse collars, in which I substitute that perfectly elastic article, air, as a stuffing, for the comparatively rigid and non-elastic materials heretofore employed, and I do hereby declare that the following is a full and exact description thereof.

The object in view is to interpose air between the hard materials, which form the foundation or more solid parts of saddles and horse collars, and those parts of them which bear upon the animal. In the general form or manner of making these articles, I do not profess to have made any improvement; all that I propose to do being merely to omit the ordinary stuffing on the bearing parts, and to cover them with leather, cloth, or other material rendered impervious to air by means of India rubber, or otherwise; so forming and fixing such covering as that when inflated, by means of a condensing syringe, the bearing parts will become distended, and assume the intended form. In some suitable part of the articles an opening furnished with a valve must be made for the purpose of attaching the syringe.

The manner in which the air-tight covering is to be attached, does not admit of, or require, any particular description, as it may be varied in numerous ways, and must be left to the judgment and fancy of the workman, who, if skilful, will be at no loss in this particular.

What I claim as my invention, is merely the substitution of air for other materials in forming a stuffing for the bearing parts of saddles and horse-collars.

Ebenezer Hale.

Specification of a patent for an improvement in the machinery for forming and hardening Rope. Granted to John Whiteman, *city of Philadelphia, January 15th,* 1836.

To all whom it may concern, be it known, that I, John Whiteman, of the city of Philadelphia, in the state of Pennsylvania, have made an improvement in the machinery for manufacturing rope, by which it may be made of any desired length in a manner more convenient than any which has heretofore been practised; and I do hereby declare that the following is a full and exact description thereof.

A shaft or spindle is to be made to revolve horizontally, in a frame of suitable dimensions, its size depending upon the nature of the work to be performed by it. This shaft runs in boxes, bearings, or collars at each end. The front end where the spinning is performed, is made hollow in the manner of the spindle of the small flax wheel, admitting the rope which is to be twisted, to pass through it in the same way. In the eye or opening thus made, at the back of the bearing of the shaft, there is a small friction pulley inserted, to enable the rope to pass readily through the perforation in the spindle. There is a reel upon the spindle, upon which reel the rope is to be wound as it is made ready therefor. This reel is so constructed as to be capable of being thrown into and out of gear, with perfect facility; this may

be effected by means of a feather on the shaft, which is received in a notch made for the purpose, in the head of the reel. The throwing out of gear is done whenever the rope is to be wound upon the reel, which when disengaged from the feather, by being slid back, engages by means of suitable stops or projections, with a wheel and pinion, furnished with a winch, by which the reel may be turned back, and the rope wound upon it.

In order to wind the rope upon the reel I employ a sliding bar, having upon it teeth, forming it into a rack, into which teeth a pinion engages, by which the rack can be moved backwards and forwards. This sliding bar is placed on one side of the frame, parallel to the shaft, and extends from front to back of the machine; its motion is governed by suitable slides. The pinion by which it is moved is placed upon the vertical shaft at the back end of the machine, where it also bears against a friction roller acting on its smooth side. There is a fixed snatch block upon the front post of the machine, and a second snatch block on the inside of the slide towards the spindle, and when the rope is to be wound upon the reel it is first passed round the pulleys of these blocks, when the reel may be turned back, and the rope distributed upon the reel by means of the rack and pinion. For a more perfect understanding of the arrangement of the apparatus by which this is effected, I refer to the drawing, with written references thereto, deposited in the patent office in conformity with the requirements of the law in that case made and provided.

Although I have in the foregoing description spoken of using one spindle only, it is to be distinctly understood that I intend to combine three, or any other number which I may prefer of such spindles, constructed and operating upon the same principle, in the same machine.

What I claim as my invention in the machinery for making ropes and cordage is the manner of distributing the rope, as within described, upon a reel placed upon a shaft or spindle, driven by any of the ordinary means of giving motion to shafts for spinning; which reel is so constructed as to engage and disengage in the manner, and for the purposes herein set forth, whether the same be applied to only one, or to a greater number of spindles in the same frame.

John Whiteman.

Progress of Physical Science.

Dissected Battery and Standard Battery of Professor Daniel.

For the purpose of ascertaining the influence exerted by the different parts of the voltaic battery, in their various forms of combination, Professor Daniel, contrived an apparatus, which he designates by the name of *the dissected battery*, and which consists of ten cylindrical glass cells, capable of holding the fluid electrolytes, in which two plates of metal are immersed; each plate communicating below, by means of a separate wire, which is made to perforate a glass stopper closing the bottom of the cell, with a small quantity of mercury, contained in a separate cup underneath the stopper, and with which electric communications may be made at pleasure through other wires passing out of the vessel on each side.*

* The arrangement seems to us much inferior in convenience, to the battery devised for similar objects, by Professor Henry of Princeton, and described in the Amer. Philos. Trans. Vol. 5, Part 2. Com. Pub.

A series of experiments performed with the dissected battery is next described; illustrating, in a striking manner, the difference of effects with relation to the quantity and the intensity of the electric current, consequent on the different modes of connecting the elements of the battery: the former property being chiefly exhibited when the plates of the respective metals are united together so as to constitute a single pair; and the latter being exalted when the separate pairs are combined in alternate series. The influence of different modifications of these arrangements, and the effects of the interposition of pairs in the reverse order, operating as causes of retardation, are next inquired into.

In the course of these researches, the author, being struck with the great extent of negative metallic surface over which the deoxidating influence of the positive metal appeared to manifest itself, as is shown more especially in the cases where a large sheet of copper is protected from corrosion by a piece of zinc or iron of comparatively very small dimensions, was induced to institute a more careful examination of the circumstances attending this class of phenomena; and was thus led to discover the cause of the variations and the progressive decline of the power of the ordinary voltaic battery, one of the principal of which is the deposit of the zinc on the platina [or copper] plates; and to establish certain principles from which a method of counteracting this evil may be derived. The particular construction which he devised for the attainment of this object, and which he denominates the *constant battery*, consists of a hollow copper cylinder, containing within it a membranous tube formed by the gullet of an ox, in the axis of which is placed a cylindrical rod of zinc. The dilute acid is poured into the membranous tube from above by means of a funnel, and passes off, as occasion requires, by a siphon tube at the lower part; while the space between the tube and the sides of the copper cylinder is filled with a solution of sulphate of copper, which is preserved in a state of satuation by a quantity of this substance suspended in it by a collander, allowing it to percolate in proportion as it is dissolved. Two principal objects are accomplished by this arrangement; first, the removal out of the circuit of the oxide of zinc, the deposite of which is so injurious to the continuance of the effect of the common battery; and, secondly, the absorption of the hydrogen evolved upon the surface of the copper, without the precipitation of any substance which would tend to counteract the voltaic action of that surface. The first is completely effected by the suspension of the zinc rod in the interior membranous cell, into which the fresh acidulated water is allowed slowly to drop, in proportion as the heavier solution of the oxide of zinc is withdrawn from the bottom of the cell by the siphon tube. The second object is attained by charging the exterior space surrounding the membrane with a saturated solution of sulphate of copper, instead of diluted acid; for, on compleating the circuit, the electric current passes freely through this solution, and no hydrogen makes its appearance upon the conducting plate, but a beautiful pink coating of pure copper is precipitated upon it, and thus perpetually renews its surface.

When the whole battery is properly arranged and charged in this manner, it produces a perfectly equal and steady current of electricity for many hours together. It possesses also the further advantages of enabling us to get rid of all local action by the facility it affords of applying amalgamated zinc; of allowing the replacement of the zinc rods at a very trifling expense; of securing the total absence of any wear of the copper; of requiring no employment of nitric acid, but substituting in its stead materials

of greater cheapness, namely, sulphate of copper, and oil of vitriol; the total absence of any annoying fumes; and lastly, the facility and perfection with which all metallic communications may be made and their arrangements varied. Abstract of Proceedings Royal Soc. in Lond. and Edin. Phil. Mag., May.

On the general Magnetic relations and characters of the Metals. By Professor Faraday.

In a paper in the number of the London and Edinburgh Philos. Mag. for March, Prof. Faraday has a paper bearing the title just quoted. He states that general views had long since led him to the opinion, that all the metals are magnetic, in the same manner as iron, though not at common temperatures; iron and nickel being no more exceptions to the magnetic relations of metals in general, than mercury is in their relations to heat. He reduced the temperatures of the following metals to 60 or 70° below zero of Fahrenheit's scale, by the evaporation of sulphurous acid, but could perceive no indications of the development of magnetism in them. Arsenic, antimony, bismuth, cadmium, chromium, cobalt, copper, gold, lead, mercury, palladiam, platinum, silver, tin, zinc. Plumbago was subjected to the same result. Prof. Faraday also investigated the temperature at which nickel loses its power of becoming magnetic, with a view to compare it with the corresponding point, for iron which is worked at an orange heat. This point was found to be, for nickel, between 630 and 640° Fah. Steel loses its permanent magnetic power suddenly below the boiling point of almond oil; between this temperature and an orange heat it acts as soft iron. The temperature at which polarity was destroyed, appeared to vary with the hardness and condition of the steel. A natural magnet, or loadstone, retained its polarity at a temperature above that at which steel lost the same power, losing it when visibly red in the dark. On the contrary, the same loadstone lost the action similar to soft iron, of becoming magnetic by induction, at a lower temperature than steel. The same results were found when the loadstone of which the magnetism had been destroyed by heat, had its polarity destroyed on cooling, by touching with an artificial magnet. Abstract from Lond. and Ed. Philos. Mag.

Ice formed at or near the bottom of Streams.

The formation of ice in such situations is thus explained by M. Arago.*
—1st. The circumstance already adverted to, that in streams the rapidity of the current, especially in falls, carries down the colder water of the surface, and mixes it with that at the bottom; so that the deepest part here is colder than in still water.

2d. The rough and pointed nature of the substances at the bottom favour the depositon of ice, in the same manner as similar asperities form the nuclei foı crystalization in solutions of salts.

3d. The motion of the stream near the bottom is retarded by friction; thus there is less impediment to the formation of the spiculæ of ice.

Mr. Farquharson, in a recent investigation of this subject,† admits that these causes are all in action, but denies their *sufficiency* to account for the *entire* phenomena.

He assumes the cause to be, that *heat radiates through water;* that the same laws prevail with respect to the influence ot the state of the *surface* in promoting radiation, in water as in air. Consequently, the *rough* surface

* Annuaire des bureau dès Long. &c. 1833. † Royal Soc. Trans. 1835, Part I.

of the stones, gravel, &c., at the bottom, enables them to radiate heat, and cool fastest, and there the ground-gru forms.

A writer in a recent number of the London Magazine of Popular Science, after showing the contrariety of the fact assumed by Mr. Farquharson, with the experiments of Melloni, offers the following suggestions:

"There is another distinctive circumstance not adverted to either by Mr. Farquharson or other inquirers, but which appears to us the most efficacious of all others to the production of the phenomena. The adjacent ground, and the bed of the river, are first cooled down by a frost to a lower degree than the water; and thus the bottom will be rather colder than the incumbent strata of water, even in the rapids, where it is soonest brought to an equilibrium of temperature; and this cooling down of the whole adjacent ground, of course, goes on most rapidly under a clear sky, by radiation at night; the ground in the bed of the river acquiring the same temperature, or nearly so, by lateral conduction.

Now solid rock is a much better *conductor* of heat than loose gravel, or sand, &c., and the former, it appears, composes the bed of the rapids, the latter of the pools. The former, therefore, conducts quickly away the slight excess of temperature in the running water of the rapids, and converts it into ground-gru. The latter conducts more slowly, and has also a greater degree of temperature to carry off; thus—the gru does not form.

Height of Waves. A writer in the Nautical Magazine (Eng.) concludes from his observation of waves after a storm in the Atlantic, that the total height was not less than fifty feet, since "a horizontal line drawn from the apex of the loftiest wave to the ship, would have intersected the main mast about half way from the deck." He gives, further, an estimate founded on the observation which follows:

"A large ship, which was for a short time in company with a frigate we were on board of, was lost sight of at intervals when she fell into the trough of the sea, and only entirely visible when both vessels happened to be on the ridge of the respective waves which bore them up: this alternation of appearance and disappearance continued until we had approached within less than a mile of the ship, for at about that distance, when one enormous wave intervened, she was hid for the last time during the approach. Her elevation from the water-line to her mast-head could not have been less than ninety feet. When both ships were depressed, they were invisible to each other; and when one was on the ridge of a wave, and the other in the trough, part of the masts of the latter were visible to the former.

The distance between the ships, and the relative proportions of the objects, should be kept in mind:—a ship compared to one of those billows would be as a mere speck, allowing the breadth of the wave to be half a nautical mile, or 3040 feet; and if we admit the wave to be only twenty feet, the ship's hull thirteen, and five for the height of the observer, the eye, when the ship was on the ridge of the wave, would be elevated thirty-eight feet above the trough in which the other was situated."

Steel for Magnets. Mr. R. Knight concludes that open-grained blistered steel is well fitted for powerful magnets; that closing the grain by heating and hammering it, though it should still remain carbonised, greatly injures it, and that the subsequent action of heat, in opening it, though it much improves the quality, does not restore it to the same openness of grain that it had at first. Trans. Lond. Soc. Arts.

Lines of equal magnetic dip in Great Britain. Mr. R. W. Fox, of Falmouth, has made a number of observations of the magnetic dip and in-

tensity in England and Ireland, and lays down from his observations the approximate positions of the lines of equal dip. A remarkable break occurs in these lines in passing from Ireland to England, the line which passes near Dublin, for example, being found on the English coast near the extremity of North Wales, or to the south of the position on the Irish side of the channel. Mr. Fox attributes an important effect on the dip and intensity to trap-dykes, and to basaltic formations; and considers that the usual elevations and depressions of a country modify both of those magnetic elements, elevations increasing the former of them. Third. Ann. Rep. Cornwall Polytech. Soc. 1835.

Temperature of the muscles in Man. By the use of thermo-magnetic arrangements, M. Becquerel has determined the temperature of the muscles in man to be 98.2° Fah. The subjects of experiment were three young men in healthy condition. Ann. de Chim. et Phys. vol. LIX.

Progress of Practical and Theoretical Mechanics and Chemistry.

On the application of the Hot Blast in the manufacture of Cast-iron. By Thomas Clarke, *M. D., Professor of Chemistry in Marischall College, Aberdeen.*

(Read before the Royal Society of Edinburgh, March, 1835.)

Among persons interesting themselves in the progress of British manufactures, it can scarce fail to be known, that Mr. Neilson of Glasgow, manager of the Gas Works in that city, has taken out a patent for an important improvement in the working of such furnaces as, in the language of the patent, "are supplied with air by means of bellows, or other blowing apparatus." In Scotland, Mr. Neilson's invention has been extensively applied to the making of cast-iron, insomuch that there is only one Scotch iron-work where the invention is not in use, and in that work, apparatus is under construction to put the invention into operation. Apart from the obvious importance of any considerable improvement in the manufacture of so valuable a product as cast-iron, the invention of Mr. Neilson would merit attention, were it only for the singular extent of the improvement effected, compared with the apparent simplicity—I had almost said inadequacy—of the means employed. Having therefore, by the liberality of Mr. Dunlop, proprietor of the Clyde Iron-Works, where Mr. Neilson's invention was first put into operation, obtained full and free access to all information regarding the results of trials of the invention in those works, on the large scale of manufacture, I cannot help thinking that an authentic notice of these results, together with an attempt to explain the cause of them, will prove acceptable to the Royal Society of Edinburgh. And that these results, as well as the cause of them, may be set forth with clearness, I shall advert,

1st. To the process of making iron, as formerly practised.
2d. To Mr. Neilson's alteration on that process.
3d. To the effect of that alteration.
4th. To the cause of that effect.

I. In proceeding to advert to the process of making cast-iron, as formerly practised, it cannot here be necessary to enter into much detail in explanation of a process, long practised and extensively known, as this has

been; nor, indeed, shall I enter into detail, farther than, to the general scientific reader, may be proper to elucidate Mr. Neilson's invention.

In making cast-iron, then, the materials made use of were three,—the ore, the fuel, the flux.

The ore was clay iron-stone, that is to say, carbonate of iron, mixed, in variable proportions, with carbonates of lime, and of magnesia, as well as with aluminous and silicious matter.

The fuel made use of at Clyde Iron-works, and in Scotland, generally, was coke, derived from splint-coal. During its conversion into coke, this coal underwent a loss of 55 parts in the 100, leaving 45 of coke. The advantage of this previous convertion consisted in the higher temperature produced by the combustion of coke, in consequence of none of the resulting heat disappearing in the latent form, in the vapours arising from the coal, during its convertion into coke.

The flux was common limestone, which was employed to act upon the aluminous and silicious impurities of the ore, so as to produce a mixture more easy to melt than any of the materials of which it was made up, just as an alloy of tin and lead serves as a solder, the resulting alloy being more easy to melt than either the lead or the tin apart.

These three materials—the ore, the fuel, and the flux—were put into the furnace, near the top, in a state of mixture. The only other material supplied was air, which was driven into the furnace by pipes from blowing apparatus, and it entered the furnace by nozzles, sometimes on two opposite sides of the furnace, sometimes on three, sometimes, but rarely, on four. The air supplied in this manner entered near the bottom of the furnace, at about forty feet from the top, where the solid materials were put in. The furnace, in shape, consisted, at the middle part, of the frustums of two cones, having a horizontal base common to both, and the other and smaller ends of each prolonged into cylinders, which constituted the top and bottom of the furnace.

The whole of the materials put into the furnace, resolved themselves into gaseous products, and into liquid products. The gaseous products, escaping invisibly at the top, included all the carbonaceous matter of the coke, probably in the form of carbonic acid, except only the small portion of carbon retained by the cast-iron. The liquid products were collected in the cylindrical reservoir, constituting the bottom of the furnace, and there divided themselves into two portions, the lower and heavier being the melted cast-iron, and the upper and lighter being the melted slag, resulting from the action of the fixed portion of the flux upon the impurities of the fuel and of the ore.

II. Thus much being understood in regard to the process of making cast-iron, as formerly practised, we are now prepared for the statement of Mr. Neilson's improvement.

This improvement consists essentially in heating the air in its passage from the blowing apparatus to the furnace. The heating has hitherto been effected by making the air pass through cast-iron vessels, kept at a red heat. In the specification of the patent, Mr. Neilson states, that no particular form of heating apparatus is essential to obtaining the beneficial effect of his invention; and, out of many forms that have been tried, experience does not seem to have yet decided which is best. At Clyde Iron-Works, the most beneficial of the results that I shall have occasion to state, were obtained by the obvious expedient of keeping red-hot the cast-iron cylindrical pipes conveying the air from the blowing apparatus to the furnace.

III. Such being the simple nature of Mr. Neilson's invention, I now proceed to state the effect of its application.

During the first six months of the year 1829, when all the cast-iron in Clyde Iron-Works was made by means of the cold blast, a single ton of cast-iron required for fuel to reduce it, 8 tons $1\frac{1}{4}$ cwt. of coal, converted into coke. During the first six months of the following year, while the air was heated to near 300° Fah., one ton of cast-iron required 5 tons $3\frac{1}{4}$ cwt. of coal, converted into coke.

The saving amounts to 2 tons 18 cwt. on the making of one ton of cast-iron; but from that saving comes to be deducted the coals used in heating the air, which were nearly 8 cwt. The nett saving was thus $2\frac{1}{2}$ tons of coal on a single ton of cast-iron. But during that year, 1830, the air was heated no higher than 300° Fah. The great success, however, of those trials, encouraged Mr. Dunlop, and other iron-masters, to try the effect of a still higher temperature. Nor were their expectations disappointed. The saving of coal was greatly increased, insomuch that, about the beginning of 1831, Mr. Dixon, proprietor of the Calder Iron-Works, felt himself encouraged to attempt the substitution of raw coal for the coke before in use. Proceeding on the ascertained advantages of the hot blast, the attempt was entirely successful; and, since that period, the use of raw coal has been extended so far as to be adopted in the majority of the Scotch Iron-Works. The temperature of the air under blast had now been raised so as to melt lead, and sometimes zinc, and therefore, was above 600° Fah., instead of being only 300°, as in the year 1830.

The furnace had now become so much elevated in temperature, as to require water around the nozzle of the blow pipes, a precaution borrowed from the finery-furnaces, wherein cast-iron is converted into malleable, but seldom or never employed where cast-iron is made by means of the cold blast. What is called the *Tweer*, is the opening of the furnace to admit the nozzle of the blow pipe. This opening is of a round funnel-shape, tapering inwards, and it used always to have a cast-iron lining, to protect the other building materials, and to afford them support. This cast-iron lining was just a tapering tube nearly of the shape of the blow pipe, but large enough to admit it freely. Now, under the changes I have been describing, the temperature of the furnace near the nozzles, is such as to risk the melting of the cast-iron lining, which, being essential to the *tweer*, is itself commonly called by that name. To prevent such an accident, an old invention called the *water-tweer* was made available. The peculiarity of this tweer consists in the cast-iron lining already described being cast hollow instead of solid, so as to contain water within, and water is kept there continually changing as it heats, by means of one pipe to admit the water cold, and another to let the water escape when heated.*

During the first six months of the year 1833, when all these changes had been fully brought into operation, one ton of cast-iron was made by means of 2 tons $5\frac{1}{4}$ cwt. of coal, which had not previously to be converted into coke. Adding to this 8 cwt. of coal for heating, we have 2 tons $13\frac{1}{4}$ cwt. of coal required to make a ton of iron; whereas, in 1829, when the cold blast was in operation, 8 tons $1\frac{1}{4}$ cwt. of coal had to be used. This being almost exactly three times as much, we have, from the change of the cold

* An incidental advantage attended the adoption of the water-tweers, inasmuch as these made it practicable to lute up the space between the blow-pipe nozzle and the tweers, and thus prevent the loss of some air that formerly escaped by that space, and kept up a bellowing hiss, which, happily, is now no longer heard.

blast to the hot, combined with the use of coal instead of coke, *three times as much iron made from any given weight of splint coal.*

During the three successive periods that have been specified, the same blowing apparatus was in use; and not the least remarkable effect of Mr. Neilson's invention, has been the increased efficacy of a given quantity of air in the production of iron. The furnaces at Clyde Iron-Works, which were at first three, have been increased to four, and, the blast machinery being still the same, the following were the successive weekly products of iron during the periods already named, and the successive weekly consumption of fuel put into the furnace, apart from what was used in heating the blast:

	Tons.		Tons.		Tons.	
In 1829, from 3 furnaces,	111	Iron from	403	Coke from	888	Coal.
In 1830, from 3 furnaces,	162	Iron from	376	Coke from	836	Coal.
In 1833, from 4 furnaces,	245	Iron		from	554	Coal.

Comparing the product of 1829 with the product of 1833, it will be observed that the blast, in consequence of being heated, has reduced more than double the quantity of iron. The fuel consumed in these two periods we cannot compare, since, in the former, coke was burned, and, in the latter, coal. But on comparing the consumption of coke in the years 1829 and 1830, we find, that although the product of iron in the latter period was increased, yet the consumption of coke was rather diminished. Hence the increased efficacy of the blast appears to be not greater than was to be expected, from the diminished fuel that had become necessary to smelt a given quantity of iron.

On the whole, then, the application of the hot blast has caused the same fuel to reduce three times as much iron as before, and the same blast twice as much as before.

The proportion of the flux required to reduce a given weight of the ore, has also been diminished. The amount of this diminution, and other particulars, interesting to practical persons, will appear on reference to a tabular statement supplied by Mr. Dunlop, and printed as an appendix to this paper. Not further to dwell on such details, I proceed to the last division of this paper, which is,

IV. To attempt an explanation of the foregoing extraordinary results.

Subsidiary to this attempt, it is necessary to discriminate between the quantity of fuel consumed and the temperature produced. For instance, we may conceive a stove to be kept at the temperature of 500° Fah., and lead to be put into such a stove for the purpose of being melted. Then, since the melting point of lead is more than 100° higher, it is evident that whatever fuel might be consumed in keeping that stove at the temperature of 500°, the fuel is all consumed to no purpose, so far as regards the melting of lead, in consequence of deficiency in the temperature. In the manufacture of cast-iron likewise, experience has taught us, that a certain temperature is required in order to work the furnace favorably, and all the fuel consumed so as to produce any lower degree of temperature, is fuel consumed in vain. And how the hot blast serves to increase the temperature of a blast furnace, will appear on adverting to the relative weights of the solid and of the gaseous materials made use of in the reduction of iron.

As nearly as may be, a furnace, as wrought at Clyde Iron-Works in 1833, had two tons of solid materials an hour put in at the top, and this supply of two tons an hour was continued for twenty-three hours a day, one half-hour every morning, and another every evening, being consumed in letting off the iron made. But the gaseous material—the hot air—what

might be the weight of it? This can easily be ascertained thus: I find, by comparing the quantities of air consumed at Clyde Iron-Works, and at Calder Iron-Works, that one furnace requires of hot air, from 2,500 to 3,000 cubical feet in a minute. I shall here assume 2,867 cubical feet to be the quantity; a number that I adopt for the sake of simplicity, inasmuch as, calculated at an avoirdupois ounce and a quarter, which is the weight of a cubical foot of air at 50° Fah., these feet correspond precisely with 2 cwt. of air a minute, or *six tons an hour*. Two tons of solid material an hour, put in at the top of the furnace, can scarce hurtfully effect the temperature of the furnace, at least in the hottest part of it, which must be far down, and where the iron, besides being reduced to the state of metal, is melted, and the slag, too, produced. When the fuel put in it at the top is coal, I have no doubt that, before it comes to this far-down part of the furnace—the place of its useful activity—the coal has been entirely coked; so that, in regard to the fuel, the new process differs from the old much more in appearance than in essence and reality. But if two tons of solid material an hour, put in at the top, are likely to effect the temperature of the hottest part of the furnace, can we say the same of six tons of air an hour, forced in at the bottom near that hottest part? The air supplied, is intended, no doubt, and answers, to support the combustion; but this beneficial effect is, in case of the cold blast, incidentally counteracted by the cooling power of six tons of air an hour, or 2 cwt. a minute, which, when forced in at the ordinary temperature of the air, cannot be conceived otherwise than as a prodigious refrigeratory passing through the hottest part of the furnace, and repressing its temperature. The expedient of previously heating the blast obviously removes this refrigeratory, leaving the air to act in promoting combustion, without robbing the combustion of any portion of the heat it produces.

Such, I conceive, is the palpable, the adequate, and very simple explanation of the extraordinary advantages derived in the manufacture of cast-iron, from heating the air in its passage from the blowing apparatus to the furnace.

Marischal College, Aberdeen, Jan. 10, 1835.

APPENDIX.

The blowing-engine has a steam-cylinder of forty inches diameter, and a blowing cylinder of eight feet deep and eighty inches diameter, and goes eighteen strokes a minute. The whole power of the engine was exerted in blowing the three furnaces, as well as in blowing the four, and in both cases there were two tweers of three inches diameter to each furnace. The pressure of the blast was 2½ lb. to the square inch. The fourth furnace was put into operation after the water-tweers were introduced, and the open spaces round the blow-pipes were closed up by luting. The engine then went less than eighteen strokes a minute, in consequence of the too great resistance of the materials contained in the three furnaces to the blast in its passage upwards.

Materials constituting a Charge.

		cwt.	qrs.	lbs.
1829,	Coke	5	0	0
	Roasted Ironstone, . .	3	1	14
	Limestone, . . .	0	3	16
1830,	Coke, . . .	5	0	0
	Roasted Ironstone, . .	5	0	0
	Limestone, . .	1	1	16
1833,	Coal, . . .	5	0	0
	Roasted Ironstone, .	5	0	0
	Limestone, . . .	1	0	0

Table showing the weight of Cast-Iron produced, and the average weight of Coals made use of, in producing a ton of Cast-Iron, at Clyde Iron-Works, during the years 1829, 1830, *and* 1833, *the Blowing-Engine being the same.*

COKE AND COLD AIR.							COKE AND HEATED AIR.							COAL AND HEATED AIR.						
1829	Weekly product of Cast-Iron by three Furnaces.			Average of Coals used to 1 ton of Cast-Iron.			1830	Weekly product of Cast-Iron by three Furnaces.			Average of Coals used to 1 ton of Cast-Iron.			1833	Weekly product of Cast-Iron by Four Furnaces.			Average of Coals used to 1 ton of Cast-Iron.		
	Tons	Cwt	Qs.	Tons	Cwt	Qs.		Tons	Cwt	Qs.	Tons	Cwt	Qs.		Tons	Cwt	Qs.	Tons	Cwt	Qs.
Jan. 7	137	18	2	8	12	1	Jan. 6	176	10	2	5	2	2	Jan. 9	375	8	0	2	12	3
14	148	2	0	6	9	2	13	181	12	2	5	0	2	16	267	18	0	2	4	2
21	148	8	2	6	11	3	20	172	5	2	5	0	2	23	270	7	2	2	3	1
28	138	9	2	7	0	2	27	178	7	0	4	19	0	30	250	9	0	2	4	0
Feb. 4	125	13	0	7	12	1	Feb. 3	164	8	0	5	4	0	Feb. 6	265	3	2	2	1	0
11	136	19	0	7	13	1	10	172	12	0	5	4	0	13	202	10	0	2	4	3
18	130	16	2	7	11	3	17	163	9	0	5	9	0	20	257	1	0	2	4	3
25	105	12	2	7	10	0	24	170	1	0	5	3	0	27	264	0	0	2	5	1
Mar. 4	101	8	1	7	17	2	Mar. 3	154	19	0	5	10	3	Mar. 6	234	13	0	2	5	2
11	111	2	0	8	2	2	10	154	16	0	5	9	2	13	238	7	2	2	7	1
18	114	10	0	7	6	2	17	151	8	2	5	9	3	20	205	13	0	2	10	2
25	110	14	0	8	8	1	24	163	17	0	5	5	1	27	217	14	0	2	2	3
Ap. 1	111	4	0	8	7	2	31	163	8	2	5	11	0	Ap. 3	220	7	0	2	14	2
8	107	7	0	8	3	0	Ap. 7	147	10	0	5	7	0	10	280	9	2	2	0	3
15	91	12	2	8	15	0	14	154	9	2	5	2	0	17	304	7	0	1	17	3
22	85	13	0	9	13	0	21	163	4	0	4	19	9	24	248	12	2	2	3	0
29	91	14	2	9	6	2	28	148	12	2	5	4	0	May 1	245	7	2	2	6	0
May 6	92	7	2	8	8	2	May 5	162	10	2	5	2	2	8	200	17	0	2	8	0
13	94	6	0	9	2	1	12	149	13	0	5	3	2	15	246	4	2	2	5	3
July 8	88	4	2	8	16	3	19	162	4	0	5	5	0	22	219	1	2	2	6	0
15	91	13	0	8	5	0	26	165	7	2	4	18	3	29	231	2	0	2	8	0
22	97	2	0	8	2	1	June 2	160	4	0	5	2	2	June 5	235	16	0	2	6	2
29	104	15	2	7	10	2	9	157	17	0	5	1	0	12	232	10	0	2	7	1
Aug. 5	106	17	2	7	7	2	16	164	0	0	4	17	3	19	271	1	2	2	1	0
12	93	1	0	8	6	0	23	149	3	0	4	18	0	26	262	3	2	2	3	1
19	113	7	0	8	18	2	30	162	16	2	4	16	3	½ w. 30	122	16	0	2	5	1
	2878	18	0	309	19	0		4215	6	0	134	6	2		6390	3	0	58	18	3
Average.	110	14	2	8	1	1		162	2	2	5	3	1		245	0	0	2	5	1

The correspondent by whom we have been obligingly favored with the preceding paper, makes himself the following remarks on the subject of which it treats.—Ed. M. M.

"The best application of the hot blast that I have yet seen, is at the Wilsonton Iron-Works, near Lanark and Whitburn. At these works the heated air is never at a *lower* temperature than the melting point of lead (612°). This is readily *tested* by inserting a small bar of lead into an opening in the pipe for the purpose, a little way before it enters the furnace; the lead is *instantly* melted. When in good working order, zinc is fused (700°) in the same way. The air is heated in passing through a series of iron-pipes of *small* diameter, fixed upright in a brick oven, and kept at a red heat; the heated air entering the furnace by *four tweers.* 'The Condie pipes,'—so called from Mr. John Condie, the manager of the Wilsonton Iron-Works, and late the Calder—last much longer than the ill-arranged heating-apparatus (with pipes of large diameter) at the Clyde Iron-Works, and effect a much greater saving in fuel.

The *raw coal* when used as the fuel, has the disdvantage of soon filling the furnace, and is also found to produce an inferior quality of iron, to that made by use of coke. It is, therefore not unlikely to be soon, generally, given up." Lond. Mech. Mag.

British Association for the Advancement of Science.

Section of Mechanics applied to the Arts.

The great press of business in the Physical Section rendered it necessary to institute a sub-section for the Useful Arts, and the increasing interest felt in the subject of Civil Engineering, induced the Association to establish it as a permanent Section of their body, under the designation of *Mechanical Science applied to the Arts.* Of this sub-section Mr. Rennie was appointed President, and Dr. Lardner, Vice-President. Mr. Eaton Hodgekinson reported the result of certain experiments which he had communicated to the Association at the three previous meetings. He also gave the result of some very curious experiments in the Fractures of Wires in different states of tension.

M. Mallet read a paper on the Fracture of bars of Cast Iron.

Mr. Pritchard exhibited an Achromatic Microscope, made by him on the principles published in his works, in which the angular aperture of the object glasses exceeds any that have yet been produced.

Mr. Ettrick read an account of a Mariners' Compass, which by two adjustments, caused the cardinal points on the card to coincide with the corresponding points of the horizon, whereby the mariner is saved the trouble of allowing for the variation in steering, and the expense of purchasing variation plates. It was effected by securing the needle upon the card by moveable clamps, and adjusting such needle for the magnetic variation of Greenwich, with a contrivance for changing it in places having a different local variation.

Mr. Ettrick read an account of certain improvements in Steam Engines, for rendering available the steam of high pressure boilers, which is below the pressure of the atmosphere, by permitting the high pressure steam to pass off into the atmosphere, and the steam of low pressure to pass off into a condenser by a secondary slide. He also gave a report of certain improvements in securing the seams of boilers, by longitudinal, instead of the present circular, clenches, and described a machine for drilling boiler plates, as rapidly as they can be punched by the punching machine. He also gave an account of certain improvements in the astronomical clock.

Mr. Russel read a paper on the Solids of Least Resistance, with reference to the construction of steam vessels, and detailed several experiments to prove, that the object would be best attained by giving a parabolic form to the prow.

Mr. Taylor, the treasurer of the British Association, made a communication respecting the monthly reports of the *duty* of steam-engines, employed in draining the mines of Cornwall; and observed, that he had found at this and other meetings of the Association, considerable interest to be expressed, with regard to this mode of recording the actual effect produced by the consumption of a given quantity of fuel, and recommended the subject to the notice of engineers in general. These reports gave the means of comparing one engine with another in the district; they also afforded an historical view of the progress of improvement in this important machine; and they had contributed largely to that improvement, by the emulation and attention excited by them, in the persons who had the charge of constructing and managing the engines. Mr. Taylor testified to the accuracy of the duty reports, declaring that he had compared them with the account books kept at the different establishments, and found that the results of both coincided.

Dr. Lardner then addressed the section on the subject of Rail-roads.

Professor Stevely described a Self-registering Barometer.

Mr. John Isaac Hawkins explained, on a model, a safe mode of Turning Corners on a Rail-road by means of Mr. Saxton's Differential Pulley. He also read an account of an interesting experiment on the evaporation of water.

Mr. Cheverton read a paper on Mechanical Sculpture, or the production of busts and other works of art by machinery, and illustrated the subject by specimens of busts, and a statue in ivory, which were laid on the table. They were beautifully executed, and excited universal admiration. The machine was invented by Mr. J. I. Hawkins, and perfected by himself.

Mr. Grubb made some observations on an improved method for Mounting an Equatorial Instrument adopted by E. J. Cooper, M. P., in his private observatory. Mr. Cooper bore testimony to the excellence of the instrument, and to Mr. Grubb's talents and zeal in scientific improvements.

Lieut. Denham, R. N. made some observations on the Vibratory Effects of Rail-roads; and a long discussion ensued between Dr. Lardner and Mr. Vignolles on the advantages arising from acclivities in rail-roads.

Rep. Pat. Invent.

Instance of human effort.—Six Days' Sawing. A pair of sawyers in the yard of Messrs. Paul and Co., timber-merchants, Broad street, Golden-square, executed the following quantity of labor in sixty working-hours, in six days, beginning about 8 A. M. on Monday, the 25th, and ending about four P. M. on the following Saturday, the 30th of January, in the present year.

They sawed through an area of 3068 square feet of American Pine, along a line whose total length was 1726 feet. In doing this, they raised the saw 124,272 times, and as this tool weighed 30 lbs., they lifted an actual weight of 3,728,160 lbs. But this amount of labour was not more than one-third the actual exertion expended; for to overcome the friction, in pulling up the saw through the kerf, and forcing it down again through the wood, at least two-thirds more was necessary; the total labour, therefore, was equal to lifting 11,184,480 lbs. to the height of the stroke, and as this was four feet, there was 44,737,920 lbs.=19,958 tons. 18 cwt. raised one foot high, in 60 hours, which is 12,427 lbs. =5 tons, 11 cwt. raised one foot high, per minute, by the two men, and 2 tons, 15½ cwt. per man, 1 foot high per minute. Lond. Mag. Pop. Science.

Improvements in the manufacture of Beet Root Sugar. In a memoir addressed to the Society for the encouragement of National Industry in France, M. Desormes alleges that the use of animal charcoal in grains for filtering the sirop, and the employment of large quantities of this decolorizing principle, is the greatest improvement recently made in the manufacture of sugar from beets. The charcoal is heated in tin plates, and finally on a cast-iron plate nearly red hot, by which the vegetable matters absorbed by it are decomposed, and the material is again fit for use in removing the color from the sirop. He states the amount of bone charcoal which may be profitably used, as high as one hundred and fifty per cent. of the weight of sugar to be obtained. Bull. Soc. d'encouragement.

Lime water used in the dressing of Wool. A patent has been taken out in England for the use of an imperfect soap formed by mixing three parts, by bulk, of a saturated solution of lime in water, with any of the oils used in the preparation and manufacture of wool. The patentee states that the substitution of this composition for oil, will save nearly three-fourths of the oil now used, and much of the soap required in cleansing.

Rep. Pat. Invent. April.

Analysis of German Silver. A recent analysis of this compound, by Mr. J. D. Smith, gave copper, 42.1, zinc 12.5, nickel 13.2, cobalt 2.4 from 70 grains of the alloy. Lond. and Edin. Philos. Mag. Jan.

Progress of Civil Engineering.

Observations on the Classification and Details of the Architecture of the Middle Ages. By E. B. Lamb, Esq. Architect.

The study of ancient architecture is fraught with difficulties: one book is examined after another; but, unless you refer to ancient buildings, you seek in vain for a brief and clear classification of the styles, dates, and systems, so essential to the beginner. Many, and voluminous, indeed, are the essays on some particular parts of Gothic architecture; but very few can give satisfactory information, fit for the practical purposes of the art. This is only to be acquired by a close examination of our ancient buildings; and, after having gleaned all that can be learned from books, in the first instance, it will be found impossible to acquire the knowledge thirsted after, without sections of mouldings, and forms which can be studied, properly, only in original buildings; as these forms are seldom to be met with large enough for practical art, in the numerous works with which the world is stocked. Architectural works, in fact, should be looked upon by the student as only the first step in his researches; as, notwithstanding the most careful and elaborate drawing which is bestowed upon their production (and which, as it is well calculated to lure the eye, and from the beautiful representations of buildings and general picturesque style which it displays, must tend much towards improvement in architectural taste,) the details are seldom sufficiently large to enable them to be as properly studied as in the original buildings. The want of this study may, in some measure, account for the deficiency in effect and correctness observed in the modern Gothic; general forms having only been considered by the architect, who, not having acquired a knowledge of the principles of detail, is driven to his own invention; and this generally creates a meagre and insipid design, seldom satisfactory to himself, and often held up to ridicule by others.

I do not mean that ancient architecture should be exactly copied in modern buildings, as this ought never to be the case, I merely recommend close study, that the spirit and feeling of the ancient artist may be understood, that a modern design may be in the spirit of the ancient style, though not in the actual style, and that the mouldings and mullions proper for one date may not be used in another. The architect should always bear in mind, that it is his duty, as it was considered by the architects of the middle ages to be theirs, to invent forms, and improve upon the architecture of by-gone days; yet still to follow the same general feeling, and to create a style perfectly distinct from any other known specimen, which shall be yet perfectly characteristic of the times and purposes for which it is intended. This is to be acquired only by the study of detail, as well as of general forms; and by a knowledge of the principles of the ancient architecture, of the forms belonging to the different periods, of the transitions from one style to another, of the nature of the materials, and of the manner of construction.

Architecture is generally considered one of the most important connecting links in the history of a country; and by the peculiarities of its style,

and its comparison with record, it affords us an interesting insight into the customs of earlier times. This being the case, it is much to be regretted that while our national museum contains some of the magnificent remains of Egyptian and Grecian art, so little regard should be paid to the remains of art in our own country, particularly at the present time, when Gothic architecture is making such rapid strides in the improvements in our cities. I have often thought, when it has been found necessary to take down an ancient building, that it was a public loss, inasmuch as the principal parts would be sold to the collectors of relics, and hidden forever, except to the chosen few. Instances of this kind are constantly occurring: ancient buildings are taken down, being considered either dangerous or inconvenient; the stone is sold, and the carvings, which have delighted and instructed many, are closeted for the benefit of one individual. This is much to be lamented, though it is at present, inevitable; but, if there were a national repository for some of the best selected of these carvings, they might be still a benefit to the world. Some time ago, the north-west tower of Canterbury Cathedral was taken down, and it is to be, or has been, rebuilt, to correspond with the other, which is of more recent date, although a very fine tower. What has become of the Norman remains of the ancient tower? Would it not have been desirable that some of the choicest fragments should be preserved in our national museum? not only as a record of that building, but as an example of early character. Many buildings are thus destroyed, and leave no trace behind, which might contribute considerably to the advancement of this style of architecture, if some of their fragments were preserved, and easy access could be had to them. At a small expense, a very perfect classification of Gothic architecture might be obtained; and, if well arranged, it would greatly tend to diffuse that taste and knowledge in architecture which is so requisite for the promotion of the art. These relics would be constantly before the eyes of the public, who would become familiarized with their forms and date; they would be considered as sacred and valuable records of the history of the art; and would insensibly lead to the preservation of ancient architecture, which has hitherto been so much neglected. It is even probable that churchwardens would catch a little of the infection, and would not suffer a fine building to be "repaired and beautified" by incompetent persons; which has too often been the case in many of our most beautiful buildings. The approaching competition for the Houses of Parliament will at least assist in improving the public taste: it will be the means of awakening the public attention to a style of architecture which raises so many agreeable associations in the mind of an Englishman. In contributing my aid to the illustration of the architecture of the middle ages, I do so with fear, at the same time that I consider it the duty of every architect to assist in promoting that general knowledge which is so essential to the advancement of art, and for the purpose of restraining the rude hands of ignorant men in power, from the spoliations which have been too often suffered by our ancient edifices. In this paper it is my intention to confine myself to a simple classification of the architecture of our own country, principally in the windows, as these are leading features in all our ancient building, and a general knowledge of their forms is a sufficient guide to the date of most other parts of the same building.

The oldest specimens of ancient architecture found in our own country may be probably dated as far back as the fifth century, and ascribed to the Romans (as here it will be unnecessary to mention those extraordinary

works commonly attributed to the ancient Druids;) and these only afford evidences of their authenticity from their mode of construction, as there are now I believe, no records remaining to throw a light upon the exact time of their foundation. The works in this style which are admitted by antiquaries to be genuine Roman works can be the only standard to refer to; and the similarity of other buildings to these will allow of conjecture as to their date. The nave of Brixworth Church, Northamptonshire, retains some of the characteristics of this style of architecture. The walls have recently, in part, been divested of their whitewash, which disfigured them, and the forms of the arches exposed: they are semi-circular, turned with bricks resembling those used by the Romans, and of various dimensions; sometimes in two rims, with a course of bricks laid flat between them, and on the outside rim the soffit of the arch raising quite plain, and at right angles to the face. Among other buildings supposed to be of this period are the remains of Richborough Castle, in Kent, and Jury Wall, Leicester. In many of the churches in Kent, Roman tiles or bricks, the remains of some arches, are still visible; though these remains may be merely the Roman materials brought from other buildings. In the tower of St. Alban's Abbey there is a window of two lights constructed with Roman bricks: in this example, the small pier between the arches may, perhaps, be considered as the prototype of the mullion of a subsequent period.

As the Anglo-Saxons were constantly involved in war, little time was given for the cultivation of the arts; but, about the time that Christianity was introduced in this country, many of the heathen temples were altered to the form required for the new religion. Some were entirely demolished, and Christian churches raised upon their foundations; but the successive invasions of the Danes, and the destruction they every where committed, have left us but few remains of this kind of architecture; and these few so much resemble the Norman style, that it requires the strongest presumptive evidence to assign a building to this period. The general forms were round arches, very few mouldings, massive columns, rudely carved ornaments and capitals, buildings generally upon a small scale, and frequently of unscientific construction. Parts of St. Alban's Abbey are probably of this date; Earls Barton Church, Barton upon Humbar, and some few others, are considered in this style.

The increased refinement in the manners of the Normans, their general love of pomp, and, above all, the comparative tranquility which succeeded to the Saxon sway, produced a new epoch in architecture; though the same general forms were used, the buildings were upon a larger scale, the mouldings were more complex, the ornaments were worked with greater exactness, and the whole improvements were such as would naturally arise from a progression of civilization.

This style is usually comprised between the years 1066 and 1189, which may also be divided into three periods. The first of these, the early style, immediately succeeded the Saxon, and retained many of its features, with very litte decoration: examples of this period may be seen in the nave of Rochester Cathedral, built by Gundulph, Bishop of Rochester, about 1077; the tower and other parts of Winchester Cathedral, built by Bishop Walkelyan, about 1080; the Chapel of the White Tower, London, about the same date; and at many other places. The middle period, or division, may be considered the most perfect of this style: the decorations were every where increased, and the chevron, the billet, label, embattled fret, indent, and nebule were among the decorations; the interlacing arches were also

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profusely used. Examples of this division may be seen in St. Bartholomew's Church, Smithfield; South Ockendon Church, Essex; the Church of the Hospital of St. Cross, built by Henry de Blois, about 1136, &c. The third division may, perhaps, more properly be called the transition style, from its consisting partly of the perfect style, showing some of the general features of the next. In this division the pointed arch was frequently used; but the ornaments and mouldings retained the same character as in the last, though wrought with an increased complexity. In some instances the pointed arch appeared earlier, as in the Church of St. Cross: in fact, this church has almost all the varieties of the Norman style. The circular part of the Temple Church in London, and Becket's Crown, Canterbury Cathedral, are in this division: in Durham Cathedral there is also some transition work.

The semicircular arch is the characteristic of the Norman style; but in it the horseshoe, the Moorish, the elliptical, segmental, and pointed arches are sometimes to be met with. Windows with three lights, the centre one being raised considerably above the sides, are to be seen in Waltham Abbey, and several other buildings. In Little Snoring Church, Norfolk, is to be seen a semicircular arch within a pointed one, and these two are encompassed by another semicircular arch, with the sides continued from the springing to the impost. There are many examples where the pointed and semicircular arches are both used in the same place, which may be evidence of transition work. *Fig.* 1. is a section of the jamb mouldings of a window

Fig. 1.

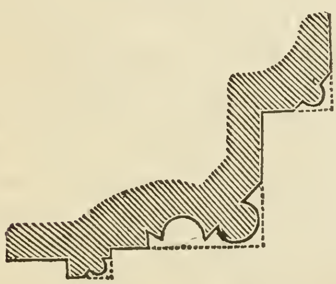


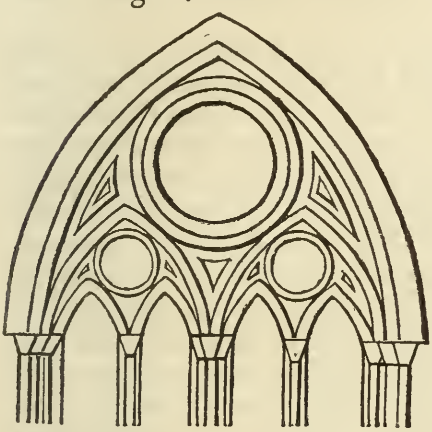
Fig. 2.

of the middle division. It will be seen by this section that the mouldings are geometrical figures, and are formed out of the flat surfaces of the arches: these arches form distinct recesses, and are very numerous in some buildings. From the peculiar character of the ornament, which, I believe, is always sunk, and never raised above the face of the stone, except in labels, strings, &c., I am inclined to think much of the ornamental work was carved when the arches were set; indeed, some unfinished work, occasionally to be met with strengthens this opinion. Cusps are sometimes found in the later divisions of this style.

The commencement of the reign of Richard I. (1169) is the period usually assigned for the general adoption of the pointed arch, and from the decided change from the massive proportions of the preceding periods to the lofty proportions of the Gothic style, and to that general tendency to perpendicular lines, instead of horizontal ones, which characterised it. Of the numerous names applied to this style of architecture each has its merit in some peculiar way, though but few can be allowed to be sufficiently compre-

hensive: under these circumstances, I will not presume to add to the catalogue of titles by which it is designated, but shall content myself with the term Gothic, which is generally applied, commonly accepted, and always understood to signify that light and elegant architecture which became general after the Norman style, and which was characterised by the use of the pointed arch and perpendicular lines, as, when so applied, its barbarous definition is never thought of.

Fig. 3.



The Gothic style may be divided into four classes: viz. 1st Class, which is composed of geometrical forms, in circles and segments of circles, with equilateral and lancet arches; 2d Class, with ramified tracery, sometimes resembling the fibres of leaves, and equilateral lancet arches; 3d Class, with perpendicular lines, and compound arches; 4th Class, also, with perpendicular lines, and compound arches continued, but increased in richness and the number of mouldings; the general proportions being, consequently, more heavy in appearance.

The First Class of Gothic Architecture, commenced in 1189, and continued till about 1272; and in the first division of this class many of the mouldings and ornaments retained some of the characteristics of the Norman style; while among its principal decorations, slender marble columns, highly polished, appear very conspicuously. These columns were introduced perfectly unconnected, except by the capital and base, and were frequently carried to a great height. Where they remain in our buildings in their original state, they produce, by their richness, a beautiful contrast to the plain stone. The square recesses of the Norman style were now changed to plain splays, chiefly in the exteriors, though the interior mouldings were still governed by the same general principles. *Fig.* 2, is a section of the arch mouldings of the east window in the north aisle of Stone Church, Kent, which will show the character of the mouldings of the middle division of this class; and their distinctive marks will be seen by a comparison with those in *Fig.* 1. The degree of progress obtained in the mouldings of this period will also be seen; and by again comparing the section, *Fig.* 2, with the elevation *Fig.* 3, something of the same geometrical character will be observed. *Fig.* 4, is a section of the window jamb, or

Fig. 4.

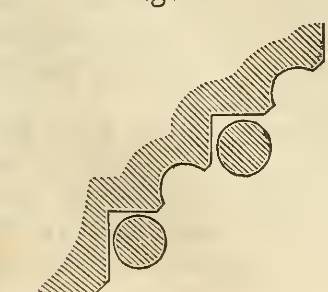


Fig. 5.

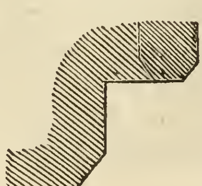


Fig. 6.

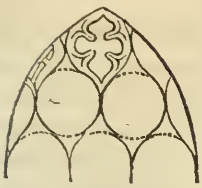
architrave, below the springing of the arch, which more distinctly shows the splaybefore alluded to: it will be proper to mention that this section is not taken from the same window as the other, as that could not be obtained, in consequence of the lower part being entirely enclosed with brickwork and plaster. In this, (*Fig.* 4.) which is from a window of two lights in the same church, are shown two isolated marble columns. *Fig.* 5, is the section of the exterior jamb moulding of the same window. *Fig.* 6, is another specimen of an exterior architrave and label moulding from Rochester Cathedral. *Fig.* 7, is a section of an exterior jamb moulding and mullion, of the first division of this class, from Rochester Cathedral.

The middle division of the first class of Gothic architecture had scarcely reached its highest point of beauty when it began to decline: and, first, the slender lofty marble column, which had been, from inexperience, formed of marble the laminæ of which were perpendicular instead of being horizontal, split into several pieces, from the weight it had to support; and, consequently, a substitute for this was rendered necessary. This was found by connecting the columns to the mullions in the last division of this style, and by running them up in smaller piers of freestone. The marble column thus gradually got into disuse; and this will account for the decay of many of our early Gothic buildings, and for the necessity, in the next class, of putting in new windows. In buildings of this period, it is not an uncommon thing to see capitals and bases without the shaft of the column. Here, we may reasonably suppose, once stood a marble shaft, which probably split and fell, though bearing little more than its own weight. In the early division of this class, few cusps were introduced into the window heads, and these were only in the perfect figures of the upper parts. Examples of this first division may be seen in Barnes Church, Surrey; Rochester Cathedral, &c.; and of the middle division, in Westminster Abby, about 1245; Wells Cathedral, 1220; and in the east end of New Shoreham Church, Essex, 1220. Stone Church, Kent, is of this division; and in this church, which is one of the most perfect specimens of this class of Gothic architecture, it is curious to observe the increase of richness in the architecture as you proceed from west to east: this practice, which is, I believe, to be seen in all our ecclesiastical edifices, is, in this one very conspicuous. Of the third, or transition, period, some examples are to be seen in Little Maplestead Church. The characteristic arches of this class are the equilateral and the drop arch, with occasionally the lancet specimens of windows. The toothed ornament was much used in this class, in the hollow mouldings; beautiful specimens of which may be seen in Stone Church, and in the arch leading to St. Bartholomew's Church, Smithfield; and also in the restored Lady's Chapel, Southwark.

Fig. 7.

The Second Class of Gothic Architecture commenced about 1272, and continued to 1377. The fault discovered in the marble columns of the preceding class was the means of their disuse; and their places soon became supplied with mullions formed of the same moulding as the tracery mullion; and the geometrical figures of the window heads of the

Fig. 8.



last class were, by slow degrees, made to take the undulating form which belongs to this class. *Fig.* 8, will show the probable origin of this style. In the first division of it, the tracery and mullions were of the simplest kind, and seldom exceeded a hollow or splay and fillet, both inside and outside: but the fertile genius of the ancient architecture soon produced improved forms; and the windows of the middle division of this class are justly celebrated for their elegance of contour and diversity of design; much of the tracery resembling in the outline the fibres of leaves. Sections of the jamb mouldings are shown in *Fig.* 10. In this section the splayed jamb shows very distinctly that the hollows are remains of the last style; but the mullion is very different. As I have endeavored to point out, in the other class, the connexion in character between the section of the mouldings and the window heads, here I will again mention this circumstance. The sections of the mouldings, *Fig.* 9, are of a less abrupt and geometrical style than those of the first class; and they partake of the easy flowing lines which are conspicuous in the tracery, and which in both are perfectly distinct from the other class. Thus it will be observed, that the ancient architects, when they diverged from the general compositions of their predecessors, retained the same spirit in the new designs; for when the change of circumstances necessarily produced a change in the buildings, the spirit of fitness and propriety was still adhered to.

Fig. 9.

Fig. 10.

The characteristic arch of this is the equilateral; and the bulb ornament, or ball flower, frequently used in the architrave, or jamb mouldings, belongs to this period: it consists of three leaves clasping a kind of round petal. In some windows this ornament is carried round the hollow of the mullions and tracery, as at Gloucester Cathedral. Examples of the first division of this class may be seen in the organ screen in Canterbury Cathedral, 1304; St. Peter's Church in the Tower of London; Chapel of St. Stephen, Westminster, about 1330, &c. Examples of the middle division of this class will be found in the spire of Salisbury Cathedral, parts of Rochester Cathedral, and in many of the churches at Oxford; and in most of which buildings there are also examples of the last, or transition, division, which may also be seen in the west end of Gloucester Cathedral.

(TO BE CONTINUED.)

Mechanics' Register.

Plate Glass. The casting of plate-glass has, since the first discovery of the invention, been an inportant branch of French manufacture. The invention is owing to Abraham Thevart, who, in the year 1688, introduced it to the notice of the French administration, and received due encouragement. Under their protection and assistance, the manufactory at the Castle of St. Gobin, three leagues from Laon, was established. This is the most extensive plate-glass foundry in France; it has gradually increased in its number of furnaces, fages, and appendages, until it now presents the appearance of a town, rather than a manufactory. A plate has been lately cast here of the extraordinary dimensions of fifteen feet by twelve, for the Château des Thuilleries. British plates are now equal in quality to the best French specimens, but they are more subject to a degree of undulation, which distorts the appearance of objects: this defect is probably owing to the mass not being continued in a sufficient state of fusion, during the progress of the operation of casting. Lond. Jour. of Arts,

The Ice trade between America and India. The arrival of the Tuscany with a cargo of ice from America, forms an epoch in the history of Calcutta. So effectual was the non-conducting power of the ice-house on board, that a thermometer placed on it did not differ perceptibly from one in the cabin. From the temperature of the water pumped out, and that of the air in the run of the vessel, Mr. Dixwell ascertained that the temperature of the hold was not sensibly affected by the ice. Upon leaving the tropic, and running rapidly into higher latitudes, it retained its heat for some time; but after being several weeks in high latitudes, and becoming cooled to the temperature of the external air and sea, it took more than ten days in the tropics before the hold was heated again to the tropical standard. Asiatic Jour.

First Tunnel under the bed of a navigable river. This tunnel has been successfully made under the stream of Black Water, at Waymouth. The river has thirteen feet of water at high tide, and seven at low. The tunnel, so called, is intended for the passage of a main gas pipe, and is seven feet high by four and a half wide. Its length is upwards of four hundred and fifty feet. Abstract Rep. Pat. Invent.

British Institution of Civil Engineers. This Institution which now numbers seventeen years since its origin, is about to publish its transactions. The publication has grown out of their weekly meetings for conversation on business connected with the profession. Ibid

Access to the Cornish mines. This is had by nearly vertical ladders interrupted at intervals by platforms. In issuing from the depth of from twelve to fifteen hundred feet the miner occupies more than one hour, and on a moderate estimate, it has been calculated, expends one fifth of his force in going to and returning from work. Ann. Rep. Cornwall Plytech. Soc.

Spider Silk. In France, M. Bon has had gloves and stockings manufactured from the spider's cocoon.

Cause of the earthquakes in the Ionian Islands. Doctor Davy finds an adequate cause for those in the access of water to the calcareous marl deposits of those engines. The marl swells when water is thrown upon it. In Aphalonia, there is a remarkable case of four descending streams of sea water, which disappeared below the surface. The subjacent strata are of the kind referred to above. An ingenious Englishman has put one of these streams to practical profit, by establishing a grist mill on its site.

Jameson's Journal.

Patent Caoutchouc Cloth. A case of considerable interest arising under the patent of Messrs. Mackintosh & Co. of Glasgow, for water cloaks, has recently been decided in the Court of Common Pleas, London, before the Chief Justice and a jury. The verdict was for the plaintiffs, Messrs. Mackintosh & Co. Lond. Mech. Mag.

List of American Patents which issued in May, 1836.

		May.
332.	*Feather dressing.*—B. S. A. Todd, Marietta, Ohio.	6
333.	*Flyer for spinning.*—Samuel Ladd, Waltham, Mass.	6
334.	*Pump.*—J. F. Walther, Easton, Penn.	6
335.	*Balance.*—Jirah Vaughan, Rutland, Va.	6
336.	*Cutting vegetables.*—Austin H. Robbins, Denmark, N. Y.	6
337.	*Horse power.*—Amos Adams, Augusta, Maine.	6
338.	*Botanic medicine.*—Samuel Thompson, Boston, Mass.	6
339.	*Shoe making machine.*—James Hall, North Bridgewater,	6
340.	*Thrashing and shelling machine.*—Nicholas Goldsborough, Easton, Md.	6
341.	*Raising water.*—Joseph Turner, Poland, Maine,	6
342.	*Thrashing machine.*—George Beaumont, Mount Pleasant, Penn.	6
343.	*Stove.*—Nathaniel Russel, Waterville, Maine,	14
344.	*Canal lock indicator.*—Valentine Brown, Clifton Park, N. Y.	14
345.	*Canal lock gate.*—Valentine Brown, Clifton Park, N. Y.	14
346.	*Water, applying.*—J. Hinds, M. B. Ball, and S. Pike, Troy, N. Y.	14
347.	*Sawing machine.*—Joseph Peevy, Levant, Maine,	14
348.	*Washing machine.*—L. R. Prince, Beverly, Mass.	14
349.	*Pearl ashes.*—J. and N. Parce, Linckland, N. Y.	14
350.	*Distilling, cold.*—A. V. H. Webb, Utica, N. Y.	14
351.	*Canal lock.*—David Wilkinson, Cahoes, N. Y.	14
352.	*Plane.*—John T. Jones, Philadelphia,	14
353.	*Grate.*—James Bennett, New York,	14
354.	*Horse power.*—Isaac Straub, Lewistown, Penn.	14
355.	*Saw mill.*—W. J. McGhee, Columbus, Geo.	14
356.	*Sawing timber.*—Joshua Webb, Brooklin, Conn.	14
357.	*Cannon traverse board.*—Wm. H. Bell, Washington, D. C.	14
358.	*Spinning machine.*—John Morgan, Manyunk, Penn.	14
359.	*Mill wheel.*—S. H. Freeman, Cecilton, Md.	17
360.	*Platform balance.*—C. P. Ladd, Irasburg, Vermont,	17
361.	*Horse rake.*—Erastus S. Root, Mount Morris, New York,	17
362.	*Brooms and brushes.*—Thos. Kinsley, Cabotville, Mass.	17
363.	*Regulating machinery.*—Nathan Scholfield, Norwich, Conn.	17
364.	*Butt Hinges.*—Jonas Rouse, Troy, N. Y.	17
365.	*Cider mill.*—Elias Jenkins, Harmony, Penn.	17
366.	*Platform balance.*—Jas. M. Peck, Syndon, Vermont,	23
367.	*Kitchen range.*—Geo. Johnson, Philadelphia,	23
368.	*Clock spring.*—Joseph S. Ives, Bristol, Conn.	23
369.	*Horse power.*—C. Custer and D. Pennypacker, Upper Providence, Penn.	23
370.	*Cart and carriage wheels.*—William Woodbridge, Kennebec, Maine,	23
371.	*Steam engine.*—A. S. Dawley, Boston, Mass.	23
372.	*Spark extinguisher.*—A. Whitney and S. S. Burr, Albany, N. Y.	23
373.	*Locks.*—P. B. Quimby, Belfast, Maine,	23
374.	*Feather dresser.*—George Reynolds, East Hartford, Conn.	23
375.	*Timber, slitting.*—R. Beale and M. Bucklin, Grafton, N. H.	23
376.	*Building stores, &c.*—Isaac Knight, Baltimore, Md.	23
377.	*Tanning.*—Simeon Heath, Pike, N. Y.	23
378.	*Water wheel.*—William Hitchcock, Spencer, N. Y.	23
379.	*Reed making machine.*—J. A. Wilkinson, Providence, R. Island,	23

CELESTIAL PHENOMENA, FOR SEPTEMBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.			
5	14	56	Im c Geminorum ,6,	101°	47°
5	16	1	Em	264	206
20	9	19	Im m Capricorni ,6,	95	104
20	10	31	Em	314	336
22	11	20	N. App. Dand σ^2 Aquarie, 5.6, ☽ N. 3.'5		

Meteorological Observations for May, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
🌝	1	44°	70°	30.24	30.20	W.	Moderate.		Clear day.
	2	58	81	30.00	30.00	SW.	Breeze.		Clear day.
	3	64	83	29.70	29.70	S. W.	do.		Cloudy—partially cloudy.
	4	67	74	29.70	29.60	NW.	do.		Lightly cloudy,
	5	48	72	30.00	30.00	N.	do.		Clear day.
	6	42	71	29.96	30.00	W.	do.		Lightly cloudy—clear.
☽	7	53	66	29.85	29.60	E. SW.	Moderate.		Rain—Cloudy,
	8	55	66	29.76	29.86	N.	do.		Cloudy—lightly cloudy, aurora B.
	9	46	66	30.00	30.06	NNE.	do.		Clear day.
	10	42	74	29.90	30.16	S.	do.		Clear day.
	11	46	78	30.04	29.19	SWS.	do.		Lightly cloudy.
	12	58	78	29.70	29.60	E. S.	do.		Partially cloudy.
	13	64	65	29.50	29.70	NW.	do.		Lightly cloudy.
	14	39	66	30.20	30.24	NW. S.	Brisk.		Partially cloudy.
⊗	15	42	69	30.24	30.20	S. W.	do.		Clear—Sun ecl'cd—clear, very dry
	16	52	80	30.05	30.00	S. W.	Moderate.	.4	Lightly cloudy—clear—shower.
	17	61	82	29.90	29.90	W.	do.		Clear—lightly cloudy.
	18	60	88	29.90	29.90	WSW.	do.		Clear—floating clouds.
	19	59	79	30.07	30.07	NW. W.	do.		Clear—floating clouds.
	20	54	80	30.10	30.10	S. SSW.	Brisk.		Clear—lightly cloudy.
	21	64	90	29.90	29.85	W.	do.		Lightly cloudy.
	22	66	86	29.80	29.80	W.	do.		Clear—flying clouds.
	23	61	81	29.70	29.70	S. W.	Moderate.		Clear—flying clouds.
	24	66	64	29.70	29.70	S. E.	Brisk.		Clear day.
	25	53	68	29.65	29.65	SE.	Moderate.	.5	Drizzle—cloudy.
	26	54	64	29.83	29.90	SE.	Brisk.		Cloudy—rains in night.
	27	47	51	30.00	30.00	E.	Moderate.	.25	Drizzle—rain—cloudy.
	28	49	67	29.86	29.83	NE.	do.		Drizzle—cloudy.
	29	62	62	29.80	29.83	SE.	Brisk.	1.20	Drizzle—rain in night.
🌝	30	48	52	29.86	29.90	E.	do.	.8	Drizzle—cloudy.
	31	44	54	29.95	29.95	NE.	do.		Cloudy—cloudy.
	Mean	53.84	72.03	29.90	29.90			1.62	

	Thermometer.	Barometer.
Maximum height during the month.	90. on 21st.	30.24 on 1st, 14th. 15th.
Minimum do. .	39. on 14th.	29.50 on 13th.
Mean do. .	62.93	29.90

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

SEPTEMBER, 1836.

Practical and Theoretical Mechanics.

On the manufacture of Military Projectiles, translated from the French of F. I. Culmann, Chef d'escadron d'artillerie, &c. &c. By ALFRED MORDECAI, *Captain United States Ordnance Department.*

(CONTINUED FROM p. 90.)

Of Rolling Shot.

Shot are rolled in a cast-iron barrel closed at the ends, having an elliptical door, and fixed on an iron axis which communicates with the shaft of a wheel from which it receives motion.

There are no fixed dimensions for such a barrel; one three feet long, twenty-two or twenty-four inches in diameter, will serve to roll as many shot as can be hammered under one hammer. The barrel should be very strong, eighteen or twenty lines thick and hooped with iron. It should be half filled; if it were less full, the shot would be less quickly polished, as we might suppose by considering the pressure which they exert on one another. This barrel ought to make about twenty or thirty turns in a minute: if the velocity were too great the shot would acquire a centrifugal force, which, pressing them against the sides of the barrel, would prevent them from acting on each other: on the other hand if the motion were too slow, or if the cask were too full, the shot would not strike with sufficient force.

When the shot are not of white metal, which, on account of its hardness, is acted on with difficulty, the charge may be renewed every two or three hours.

Rolling polishes the surface of the shot and exposes slight flaws; but it cannot correct a defect of sphericity, nor can it remove the marks of the seam and the gate. We are far from thinking that it can be substituted for hammering, which ought necessarily to follow it. Shot which have been first rolled may be hammered more quickly and at a lower heat, and receive a much finer surface. The small expense therefore which it occasions, is compensated in hammering, by a saving of fuel and labor: of undoubted advantage to the service of the artillery, its adoption will not increase the expenses of the founder.

Even if the shot were perfectly spherical when they come out of the polishing barrel, it would be better to have them hammered, because the hammer subjects them to a certain proof, very imperfect it is true, and because rolled shot are liable to oxidation, whilst those which have been hammered are covered by a slight coat of oxide, which generally protects iron and preserves it from further oxidation.

Of Hammering Shot.

The object of hammering is to make the shot more spherical and its surface more even, by removing all the little irregularities, the mark of the gate and that of the seam. The operation is performed on the heated shot, under a hammer weighing from sixty to seventy kil, (130 to 150 lbs.) the face of which is a spherical cup of the depth of eight or nine lines.

The shot are heated in a reverberatory furnace of a particular construction. The floor, which is inclined, is from fifteen to eighteen feet long, and eighteen inches wide. The height of the arch is fourteen inches. The shot introduced at one end of the furnace, descend by the inclination of the floor, and reach the point where the heat is greatest; when they have acquired the requisite degree of heat they are taken away by the workmen, whilst other shot descend into their places. By such an arrangement the work is facilitated and the shot are left the least possible time exposed to the greatest heat, which prevents too great an oxidation. The scales of oxide fall off under the hammer, and leave on the shot marks of a depth proportionate to the thickness of the scale.

At Hayange, wood is used for heating the shot; at other places coal has been successfully employed. The degree of heat ought to depend both on the nature of the metal, and on the degree of imperfection in the form of the shot. If it is nearly spherical, especially if it has been first rolled, and if the metal is good, of a clear grey, it may be heated very low, to a brownish red only, and the shot will be the better. In general, cast, like wrought iron, when worked under the hammer or between rollers, at a very low temperature, has a finer appearance than if the temperature had been higher. But if the shot be not spherical, or if it be of white metal, it is necessary to heat it very much, and to suffer the disadvantages which result from it. A great many of these shot then break under the hammer and the others are always defective. This never fails to occur when they are cast with white metal.

They are generally heated at Hayange, only to cherry red. A workman draws the shot with a hook to the mouth of the furnace, another seizes it with the tongs and carries it first, according to the old practice, to the filer who removes the seam and the gate with a rasp.

This operation is faulty, because the filer often takes off too much metal on one side, and makes the shot sometimes too small; always more or less irregular in form: it is not practised with shot cast in sand, and might very well be also dispensed with for those which are cast in iron moulds, although their seam is thicker than that of the others. The workman who has carried the shot to the filer, takes it again, and places it under the hammer, where another turns it with the tongs so that it may be hammered in every direction, but principally on the seam and on the gate. It should receive from 120 to 150 blows of the hammer to pass inspection.

If the shot has not been rolled, it is necessary to prolong the hammering on the seam, in order to flatten it entirely; the yielding of the metal to this compression, produces an elongation towards the poles. This effect is imperceptible in shot which have been first rolled; because after that operation there remain but slight traces of the seam which disappear at the first blows of the hammer, and because, moreover, they ought to be heated and hammered at a low temperature.

A small stream of water is made to drop constantly on the shot; insinuating itself between the metal and the coat of oxide, it evaporates, throws off the scales, and increases the polish of the surface. When the shot has been sufficiently hammered, the workman who has brought it pushes it down with another, so that the hammer is not stopped. But in spite of the attention and skill of these workmen, it is impossible that a hammer which strikes 200 times in a minute, should not sometimes strike foul when the shot is changed; it would therefore be better to stop the hammer, either by supporting it with a prop, or disengaging it from the moving power. These foul strokes leave very deep marks, because the hammer and the anvil are both hollow and the edges are consequently very sharp. For the same reason even the hammer makes small marks, though much less perceptible than those of which we have just spoken, when it is badly fixed on the handle, or when, by use, it has been thrown out.

In passing from one caliber to another a little larger, it is not necessary to change the hammer or the anvil; it is sufficient to heat them a little, in their places, and to make the hammer strike on a cold hammered shot, of the caliber of those which are to be next hammered.

If the shot is not spherical when it comes from the mould, it can be made perfectly so by hammering, provided the inequalities are not too great, and that the metal is grey. A slight elongation then disappears entirely. A flattening at the poles is more difficult to correct.

Comparison between Shot cast in Iron Moulds and those cast in Sand.

Shot cast in iron moulds are generally less round than those cast in sand; they have besides the defect of a coating of white metal two or three lines thick, even when they have been cast from the best metal, that which is clear grey.

This coat of white metal proceeds from the sudden cooling of the metal when poured into these metallic moulds, which are undoubtedly the best conductors of heat. Owing to these two circumstances it is necessary to expose these shot to a high heat, for the white metal is difficult to hammer. Their surface becomes therefore much furrowed, and, notwithstanding, it is not always practical to make them spherical. There are also many kinds of iron which do not bear a great heat. Shot made of such iron, when heated to a rose red, begin to break under the hammer, the white metal

especially then breaks very easily, and yet it is this kind which requires a high heat in order that all the roughness may be removed.

Depressions and swellings, in short any defects of sphericity, will still appear after hammering, if the metal is white; and the shot will be besides too small.

Whatever care may be taken to skim the metal when it is poured into the mould, there will always enter a certain quantity of dross; the metal is also oxidated in passing through the air. This dross and this oxide, being at a high heat, may combine with the sand of the mould which absorbs them. In the iron moulds, on the contrary, they float on the surface of the metal, and collect at the upper pole of the shot, around the gate. These impurities are partly removed by hammering, and leave their impressions on the surface of the metal; another part of them is incrusted still more firmly on the surface of the shot which then becomes rough, uneven and scarred, or according to the expression of the workmen, *scabby.*

These defects are increased by the use of an impure metal, mixed with silex, such as the metal obtained by the use of coke of inferior quality: it may be known by its want of fluidity.

We see then that shot cast in iron moulds are defective:

1st. From want of uniformity of dimensions which prevents the requisite accuracy;

2nd. From want of sphericity;

3rd. From having a rough and furrowed surface, principally at the upper pole.

From these causes they are of a quality very inferior to that of shot cast in sand; there would besides be little gained by rolling shot cast in iron moulds, because their surface is too hard.

The faults just mentioned are not found to the same extent in all founderies, although they are inherent in this method of fabrication. On the other hand, shot which are cast in iron moulds, have a greater specific gravity than those cast in sand. This fact which seems at first sight so singular, is easily explained: we have already remarked that by a greater compression of the sand, we may obtain, with the same model, smaller shot than if the sand were loose, on account of the resistance offered to the expansion of the metal; now this resistance is very much increased by the use of iron moulds closely wedged together. Another cause of the greater specific gravity of such shot is connected with their greater defect, the coat of white metal which envelopes them, and which resists the operation of the hammer. There are some metals however, which are very little whitened by sudden cooling, and shot made of them, when cast in iron moulds, may be perfectly spherical after having been hammered.

Shot cast in sand, although always less indented than those cast in iron moulds, are yet somewhat so, and become more so in proportion as the metal is less pure and less fluid. This indented surface is owing to the scales of dross detached from it, or pressed into it by the hammer.

These impurities may be produced in the furnace, or they may adhere to the shot before they are taken to the furnace: accidental causes may also occasion them. Argillaceous sand, or mud adhering to the surface, may become vitrified in the fire by absorbing oxide of iron, and may produce indentations. A rusty shot has not so fine a surface after hammering as a clean one. It is therefore very improper to throw shot into the mud, or to expose them to rain, after they have been cast. The sand which comes from the mould, and which has not been entirely removed by the rasp, may

also occasion these defects; hence again the advantage of having shot rolled before they are hammered.

Cavities, more or less apparent, are great defects in shot; almost all shot have a cavity in the centre, and when there is none, it is remarked that the metal is less dense or more spongy there than in other parts: it always appears a little grey at that point, even if it is otherwise white. But the principal cause of rejection in some founderies, is the existence of small cavities near the superior pole of shot; these holes are often so small on the exterior that it is difficult to introduce a pin, but they are sometimes deep and always large within, and form real chambers. The shot cast of liquid white metal have not this defect; it appears more decidedly in proportion as the metal is less liquid and more grey. It is probably for the same reason, less sensible in shot cast in iron moulds.

The hammer does not afford a test of these shot which are full of little cavities; it breaks only those which are of white metal, or those which have been too much heated. Shot which are too small may be corrected by being heated and very slowly cooled, which is performed by placing them in hot cinders, or small live coals mixed with ashes, and letting them remain twenty-four or forty-eight hours. They must then be hammered a second time, because their surfaces become oxidized and very rough. These shot also are frequently made larger by hammering. It would therefore be a very bad way of trying to diminish the diameter of the shot by hammering it repeatedly. It can be done only by oxidizing it very much, which, at last, lessens the size of the shot by corrosion; but the surface becoming in that case very much indented, that operation should not be permitted.

It has been attempted to make use of broken or unserviceable projectiles, by recasting them in the Wilkinson furnace; but that operation which was performed in the arsenals has not been found, in any respect, advantageous. Cast-iron melted a second time, where it is of a good quality, generally gives better results than are obtained from the ore; but iron which is to be melted a second time ought to be of a grey colour, and obtained from ore of rather a refractory kind; it is also necessary that it be melted in crucibles of considerable height. When these conditions are not fulfilled, the metal cannot acquire sufficient fluidity, it becomes thick, white, and unfit for casting in moulds. Now the iron of broken projectiles, generally obtained from very fusible ores, almost always inclines to white; this tendency must be much increased by melting it in low furnaces; if the height of the crucibles were increased, a greater power would be required to move the bellows. It is to be remembered also, that good shot cannot be obtained without rolling and hammering, operations which require machinery, the establishment of which would be disproportioned to the object in view. These shot too, after having been rolled and hammered, would probably be inferior to those which may now be obtained at the founderies; since the material of them is not adapted for melting a second time, particularly when that operation is performed in low furnaces.

The experiments just mentioned, prove, however, that it is possible, by means of very simple contrivances, to make serviceable shot out of broken pieces, or shot of other calibers than those required. If therefore, in a besieged place, the supply of shot should fail, a certain quantity might be procured by this means: and if the quantity of material were sufficient to authorize it, a rolling barrel might be cast, and the shot would then be very good.

Of the inspection of Projectiles.

The following instruments are used for the inspection of projectiles:

1st. Cylinders, five calibers long, the diameter of which is one line less than that of the piece if for field pieces, and one line and a half for siege pieces.

2d. Three gauges, the largest has the same diameter as the cylinder, the smallest nine parts less for shot, one line less for bombs, and six parts less for six inch and twenty-four pound howitzes; the intermediate gauge is of use only to test the accuracy of the fabrication: if good, three-fourths at least of the projectiles ought not to pass through that gauge, although none can be rejected, if they should all pass through it. It was an error to prescribe, as was formerly done, to obtain projectiles of a mean diameter between the two gauges: the effort should always be to approach as nearly as possible to the larger.

3rd. Callipers, with gradual limbs, of different sizes, to measure the thickness of metal in hollow projectiles.

4th. Probes, or gauges, for measuring the thickness of metal at the point opposite to the eye.

5th. Cylinders for verifying the interior and exterior diameters of the eye.

6th. Gauges cut in small pieces of sheet iron, showing the maximum and minimum thickness of the shell at the eye.

7th. A hand hammer, with one face flat, and the other pointed.

8th. Benches, or tables, of thick plank.

9th. Fine pins for discovering and sounding cavities.

Of the inspection of Hollow Projectiles.

Under this head are included grenades, twenty-four pounders, six inch and eight inch howitzes; ten inch and twelve inch shells.

Before commencing the inspection, the instruments should first be carefully examined. The hollow cylinders as well as the ring gauges, are tested with verifying cylinders, intended for that purpose only. The gauges for the eye are measured with a nonius or else with a caliber ring made for the purpose. It is not necessary to make frequent verifications of these gauges, because their diameters cannot increase. Not so with the ring gauges, they should be verified whenever they are used, as the friction to which they are exposed in the inspections tends to increase their diameters.

The points of the callipers wear away very rapidly; they should therefore be frequently examined by closing them, and seeing if the points touch each other, when the upper branch corresponds to the zero of the graduated limb: the same remark applies to the probe.

The variations allowed in the thickness of the metal, or the differences between the respective maximum and minimum, are one line for twenty-four pounders, and six inch howitzes; two lines for eight inch shells, and four lines for ten and twelve inch. Formerly a variation of two lines was allowed for six inch howitzes, but one line is amply sufficient; eighteen parts would be enough for eight inch shells, and two lines for twelve inch; that is, one line above and one below the diameter of the intermediate gauge.

The variation allowed for the thickness of the culot, is generally one half of that allowed for the sides of the shell, except in six inch and twenty-four pound howitzes, in which the same variation is allowed, if indeed, they are not concentric.

There are no determinate variations allowed for the eyes; but Gassindi

recommends the rejection of shells the eyes of which differ three parts from the given dimensions. The exterior diameter differs one line from the interior, in bombs, and nine parts in howitzes.

The cylinder gauge is not used for bombs, and might without any inconvenience, be dispensed with for howitzes; it is much easier to judge of the roundness of these large projectiles, by applying the intermediate ring gauge, than by letting them roll through a cylinder inclined one inch in five calibers; as prescribed in the aide-memoire.

In order that the inspections may be made without confusion, and with proper accuracy and rapidity, the work should be divided between, at least, four inspectors, assisted by four or six gunners. One inspector holds the ring gauges, another measures the thickness of the shell at the eye and examines it with reference to flaws or cavities: a third verifies the thickness of metal at the sides; a fourth, the thickness at the bottom: the gunners clean the projectiles, place them on the bench, pass them from one inspector to another and then throw them on the pile to which they belong.

The inspector who has the ring gauges, rejects all the shells that will not pass through the larger gauge, or that pass through the smaller one, even in one direction. He distinguishes those that pass through the intermediate gauge, and they are placed in a separate pile, after they have passed the other inspectors. He examines them with respect to sphericity, which is easily judged of by the assistance of the gauges, and he rejects those which are either flattened or elongated at the poles.

The inspector whose business it is to examine the flaws or cavities, begins by measuring the thickness at the eye, he then inserts his finger, to discover interior cavities, which are sometimes numerous, and which are a cause of rejection. He afterwards examines the exterior, particularly at the gate, or near the eye. If he sees at once, that the metal is not compact, he searches the cavities and rejects the shell if he finds any cavity which becomes larger in the interior, or which extends to the depth of two lines. He strikes with the face of the hammer around the eye, to detach any scales that may be found there, and to judge by the sound, of the density of the metal. If he has doubts with regard to a cavity, he uses the point of the hammer, but cautiously, so as not to injure the shell too much; if there is a decided cavity, he strikes forcibly in order to lay it open, and to deface the shell which is then rejected. In the contrary case, if the dimensions of the eye are within the prescribed limits, and if there are no other defects, he passes the shell to the next inspector.

The inspector who has the callipers measures the thickness of the sides in four places: it is essential that the points of the callipers should be applied to the seam, the only circle on which the callipers can measure the normal thickness; the *minimum* thickness indicated by the callipers must be always taken. Finally, the shell is passed to the person who has the probe. The manner of using this instrument depends on its form. If it be so constructed that the stem can in any way be placed exactly in a direction perpendicular to the plane of the seam, and to the surface of the projectile, it is sufficient to place it with care, and to take the measure indicated, either by the nonius or by a simple division. When the probe has not such a construction, its position must be a little varied, as is done with the callipers; but the measure of the thickness of the culot must be the *maximum* shown by the instrument, because the greatest thickness is necessarily found on the line of the poles. These trials are very rapidly

made, a great facility being soon acquired by practice, because the requisite motions are few and limited.

It is to be observed that the sides of the eye do not serve as a guide for placing the stem of the probe in the direction of the line of the poles; the axis of the eye may often be out of that line, as we may suppose from the manner in which the shell is finished; the eye being reamed out when the metal is hot, and the reamer being guided only by the hand of the workman. Hence, the slightest deviation, almost imperceptible at the eye, will throw its axis out of the direction of the poles. On this account it is often requisite to vary a little the position of the instrument, which is also frequently rendered necessary by accidental circumstances met with in the shell; such as a slight cavity, or small projection, not sufficient to cause its rejection. In that case we must place the instrument by trial, even if it should have the advantage we have mentioned; as has for instance, the one invented by Col. Moret. It often happens, that a defect is not sufficiently great to cause the rejection of a shell, whilst it may still be rejected for a number of such small defects.

Bombs are inspected in the same manner as howitzes. Great attention should be paid to the ears, the metal of which is not always sound; that is the weak part of this kind of projectile. It is also necessary that the rings should have free play, and should fall down entirely on the surface of the shell. Bombs are scarcely ever rejected for the irregularities in the thickness of the sides, because the variations allowed are so great that even the least skilful workmen seldom exceed them.

Of the inspection of Shot.

The inspection of shot is much more simple than that of shells. When they are well cleaned, (and they should always be inspected as soon as they come from the foundery, before they become covered with rust,) they should be very carefully examined, and the cavities searched with a pin as in the case of shells. They are made to turn in the large gauge, and the small gauge is then applied to them in several directions: their roundness is judged of by means of the intermediate gauge. They are rejected for depressions, flaws, or other cavities of two lines in depth. Those that pass this inspection are made to roll through the cylinder gauge which should have an inclination of two inches in a length of five calibers. The shot which pass through the intermediate ring gauge, are placed in a separate pile.

The cylinder should be frequently turned that it may not be too much worn on one side. When a shot becomes wedged in the cylinder it is pushed out at the upper end, with a wooden handle. Formerly, when shot were cast in iron moulds, this accident very often occurred; not being spherical they sometimes passed very easily, in several directions, through the ring gauge, and afterwards stopped in the cylinder. About twenty of the shot received should be weighed; their weight is generally greater than that given in the tables, or than their denomination calls for; because it is endeavored to obtain shot which approach the dimensions of the large gauge, whilst the tables have been calculated on the diameter of the intermediate gauge. If this principle were strictly observed, the fabrication would be easier, but the shot would have greater windage than those which are now made, and in this respect, would be less serviceable.

The contractors remove at their own expense the projectiles which are rejected; but as their interest should be consulted as far as is compatible wit

that of the service, partial inspections are made at the founderies, and these give rise to the greater number of rejections.

Report of Thos. Jefferson Cram, Principal Assist. Prof. Nat. and Exp. Philos. U. S. Mil. Academy, upon experiments relative to the strength of Cast-iron beams.

[COMMUNICATED BY PROF. A. D. BACHE.]

1. Soon after the destructive conflagration which devoured a large and valuable portion of the city of New York, last winter, as a very natural consequence, the attention of capitalists became more fully awakened to the importance of constructing fire-proof buildings. Accordingly a demand was made upon Gov. Kemble, Esq. Principal of the West Point Foundry, for estimates of the cost of furnishing cast-iron, to replace the combustible parts which had hitherto been used in the interior of store houses and shops. To answer fully the demand which had been made upon him, Mr. Kemble thought it expedient to make a careful series of experiments upon the relative strengths of cast-iron beams of various forms, in order to ascertain, beyond a doubt, those which would be convenient for the particular object in view, and which would, at the same time, afford the greatest strength with the least cost. Through the politeness of Mr. Kemble, I had an opportunity of being present at the time of subjecting his cast-iron beams to the test of experiment; and believing that the results of those experiments will prove highly useful to the cause of constructions in general, the writer of this begs leave to make them public through the medium of the Journal of the Franklin Institute.

2. It is presumed that the accompanying drawings will enable the reader to understand the forms of the experimental beams, it being remarked, that, in each case, the form was such as would be generated by giving the figure representing the cross section, a motion of translation only, along a straight line—keeping the moving area constantly perpendicular to the line of motion. The lower rectangle, *e e*, *f*,*f*, would thus generate the "lower rib," and the upper rectangle *a a*, *b b*, would generate the "upper rib," of the beam; and the rectangle, *c*, *d*, *d*, *c*, would generate what we shall call the vertical plate of the beam. It will be seen at once, that almost any distribution of a given quantity of material, may be effected, by merely varying the dimensions of the rectangles in constructing the pattern for the casting.

3. The arrangement, for augmenting at pleasure, the pressure upon the beam, consisted of a combination of levers—one of which being a large Roman steelyard with a scale at the extremity of the longer arm: a small weight being placed on the scale, had its effect greatly augmented by the combined multiplying effects of the levers; and this increased effect was exerted by means of a cylindrical piece of iron laid straight across the middle of the top surface of the beam; so that the pressure acted uniformly along the transverse line of the middle of the upper surface of the beam. By this arrangement a small weight could be carefully applied to the scale of the steelyard without exerting a percussive effect.

4. In every case, the beam was supported by resting each of its extremities upon a well squared piece of iron about two inches in diameter, so that before exerting any pressure upon the beam, the bearing of each extremity was about two inches; and it may be well to remark here, that, immediately after the beam felt the pressure, the extremities bore only upon the inner

edges of the supporting pieces of iron; and hence, the "distance between the points of support" in what follows, must be regarded as the perpendicular distance between the inner surfaces of said supporting pieces of iron.

5. The pressures exerted are expressed in English pounds avoirdupois; the linear dimensions are expressed in English inches and parts, and the superficies in square inches. The dimensions were measured several times and when any difference was found, a mean of the whole was taken as the final result. The drawings are all made upon a uniform scale, the top and the front views containing, of course, but a small portion of the beam in length. The depressions recorded in the tables, were measured with the utmost care.

6. EXPERIMENT I.

Fig. 2.

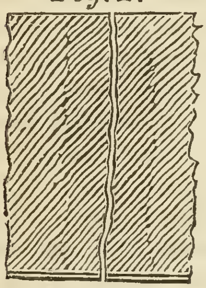


Fig. 4.

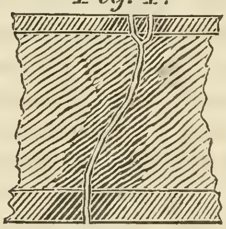


Fig. 3.

Fig. 1.

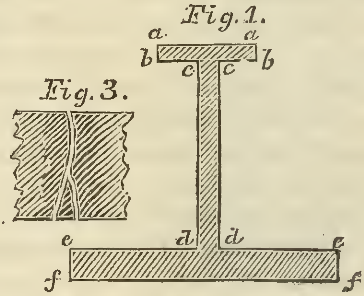


Fig. 1. represents a cross section of the beam.
Fig. 2. a top view of the fracture of the lower rib.
Fig. 3. " " upper "
Fig. 4. a side view of the fracture of the beam.

Dimensions, &c.

Depth, *a*, *b*, of upper rib,	0.31 in.	Breadth *a*, *a*, of upper rib,	2.36 in.
" *c*, *d*, of vertical plate,	4.15	Thickness *d*,*d*, of vert. plate	0.394
" *e*, *f*, of lower rib,	0.66	Breadth *f*, *f*, of lower rib,	6.74
total of the beam,	5.12		

Area *a*, *a*, *b*, *b*, of cross section of upper rib, (in sq. in. and parts,)	0.7316
" *c*, *d*, *d*, *c*, of " of vertical plate, "	1.6351
" *e*, *e*, *f*, , of " of lower rib,	4.4484
" t ota o " of beam,	6.8151

Total length of beam, 60 inches; distance between points of support 54 inches; and weight of the beam 105 lbs.

Circumstances.

The pressure being exerted upon the top of the upper rib, the upper part of the beam experienced a compression of its particles; and the lower part an extension of its particles. Augmenting the pressure by degrees—so carefully however, as not to produce a percussive effect—the beam bent more and more as the pressure increased, until of a sudden it ruptured. The annexed table exhibits the depressions of the middle of the beam in proportion as the pressure was augmented.

Pressures upon the middle.	Depressions of the middle.
½ (105) = 52½ lbs.	0.00 in.
15676	0.28
17244	0.32
18028	0.34
19596	0.40
20380	0.42
21948	0.46
23516	0.52
25084	0.58
25868	Beam broke.

No indications of rupture were observed during the successive augmentations of the pressure, until the beam suddenly broke under the last pressure recorded in the table; and the whole time between the applications of the first and last pressures was nearly twenty-five minutes. The drawings faithfully exhibit the appearance of the fracture; and it will be perceived that the fracture of the top of the beam was produced by compression, and that of the bottom by extension. Dividing 25868 lbs. by 6.8151 square inches, it will be found that this beam broke under a pressure of 3796 lbs. per square inch of cross section; and an inspection of the table will show the circumstances of its resistance to flexure. It should be remarked, that this beam was cast on its side, and therefore had less strength than if it had been cast on end.

7. EXPERIMENT II.

Fig. 6.

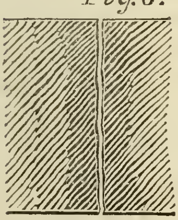


Fig. 7.

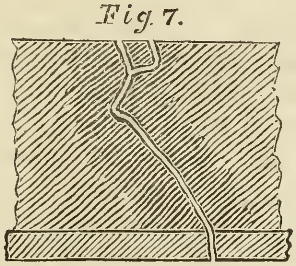


Fig. 5.

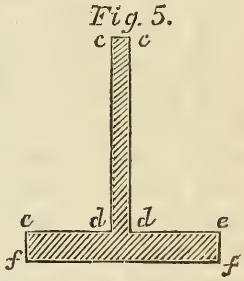


Fig. 5. represents a cross section of the beam at the place of fracture.
Fig. 6. a top view of the fracture of the lower rib.
Fig. 7. a side view of the fracture.

Dimensions, &c.

No upper rib,	0.00in.		
Depth *c*, *d*, of vertical plate	5.10	Thickness *c*, *c*, of vert. plate	0.46in.
" *e*, *f*, of lower rib,	0,74	Breadth *f*, *f*, of lower rib,	5.12
" total of beam,	5.84		

Area *c*, *c*, *d*, *d*, of cross section of vertical plate (in sq. in. and parts,)	2.346
" *e*, *e*, *f*, *f*, of cross section of lower rib, "	3.7888
" total of cross section of beam, "	6.1348

Total length of beam 60 inches; distance between points of support 54 inches; and weight of the beam 97 lbs.

Circumstances.

There was no upper rib to this beam; therefore the pressure was exerted upon the top, *c*, *c*, of the vertical plate so as to compress the upper parts of the beam and to extend the lower parts. The pressures were augmented at intervals of a few minutes, and with all possible care to prevent percussion. The following table contains the pressures exerted, and the corresponding depressions, which were carefully noted.

Pressures upon the middle.	Depressions of the middle.
½ (97) = 48½ lbs.	0.00 in.
15672	0.28
16456	0.28
17240	0.32
18024	0.32
18808	0.36
19592	0.38
20376	0.40
21160	0.42
21944	0.46
22728	0.48
23512	0.54
24296	Beam broke.

No signs of a rupture appeared until all of a sudden the beam broke a few seconds after the application of the greatest pressure recorded in the table: the whole time between the applications of the first and last pressures, was about thirty minutes. The drawings show, that the fracture at the top was produced by compression, and that at the bottom, by extension of the particles of the beam. Dividing 24296 by 6.1348, we obtain 3960 lbs., for the pressure per square inch, of cross section, which this form of beam sustained before breaking. The table shows the state of the flexure at the different periods of the operation, and the drawings will explain the peculiarities of the fracture. This beam was cast on end; and it will be seen, that this form sustained more, before breaking, by 164 lbs. to the square inch of section, than that of Experiment I.

8. EXPERIMENT III.

Fig. 9.

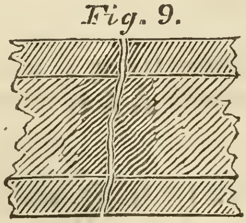


Fig. 8.

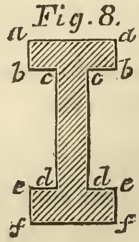


Fig. 8. is a cross section of the beam when rupture took place.

Fig. 9. a side view of the fracture. The fractures were nearly straight across the ribs.

Depth, *a*, *b*, of upper rib,	0.800in.		
" *c*, *d*, of vertical plate,	3.12	Breadth *a*, *a*, of upper rib,	2.42 in.
" *e*, *f*, of lower rib,	0.80	Thickness *c*, *c*, of vert. plate.	0.94
	——	Breadth, *e*, *e*, of lower rib,	2.42
" total of beam,	4.72		

Area *a*, *a*, *b*, *b*, of cross section of upper rib, (in sq. in. and parts,)		1.9360
" *c*, *c*, *d*, *d*, of cross section of vertical plate,	"	2.9328
" *e*, *e*, *f*, *f*, of cross section of lower rib,	"	1.9360
" total of cross section of beam,	"	6.8048

Total length of the beam 60 inches; distance between points of support 54 inches; and weight of the beam 102 lbs.

Circumstances.

This beam very suddenly broke under (the first pressure applied,) 15674 lbs. Indeed, it was doubtful even whether that amount of pressure had yet been fully exerted. Admitting however, that the whole pressure was felt, the beam broke under a pressure of only 2304 lbs. per square inch of cross section; and if the whole amount of pressure was not exerted, of course the beam was still less strong. This beam was cast on its side from the cupola furnace, and with no selection of metal, but all from one ladle. The sudden rupture of this beam made it impossible to measure the depressions. The drawing of the fracture would seem to indicate that it broke by extension.

EXPERIMENT IV.

9. The beam tried in this experiment, was exactly of the same form and dimensions as that of experiment II.; but it was not so good a casting. It was placed with its rib uppermost, in a manner exactly the reverse of that described in experiment II., so that the pressure was exerted upon the top surface of the rib, the beam resting with the edge of the vertical plate upon the supports; and thus causing a greater portion to experience compression, and a less portion to experience extension, than in either of the other experiments. Under these circumstances, the beam ruptured very suddenly even before the pressure arising from the apparatus of levers alone, had been brought to act fully upon the rib; thus affording a striking example of the great gain of strength, by giving a proper position to the beam with respect to the manner in which its different parts are to be strained—whether by compressing or by extending its particles.

10. Representing by 1.00 the strength of beam in experiment I., per sq. inch of cross section, the relative strengths of the different forms to resist rupture, will be expressed as follows:

Beam of the form described in Exp.	I.,	Strength to resist rupture,	1.00
Beam of " Exp.	II.,	" "	1.04
Beam of " Exp.	III.,	" "	0.44

By comparing the areas of the cross sections of the different forms, it will be seen that greater strength may be gained, at a less expense of metal, by giving the beam the form in experiments I. and II. instead of the form in experiment III.

All of which is respectfully submitted.

Tho. Jefferson Cram.

To Prof. A. D. Bache, Univ. of Penn.

West Point, June 1836.

NEW PATENT LAW.

We insert the law recently passed, regulating the granting of patents for useful inventions. In many of its provisions it is undoubtedly a real improvement upon the old law; there are, however, some enactments in it which we think objectionable, and others, the beneficial operation of which, may admit of much doubt. The exercise of the judicial power given to the office will require much knowledge, great prudence, and a kind and liberal feeling towards applicants, in doubtful cases. Several alterations would have been urged previously to its passage, but in the state of Congressional business a trifling opposition would have defeated it altogether, and it was thought better to break up the old system, as amendments will be more readily grafted on the new, perfection not being looked for in what is untried. We shall offer some extended remarks upon this subject at an early day. EDITOR.

An act to promote the progress of useful arts, and to repeal all acts and parts of acts heretofore made for that purpose.

Be it enacted, by the Senate and House of Representatives of the United States of America in Congress assembled, that there shall be established and attached to the Department of State, an Office to be denominated the Patent Office; the chief officer of which shall be called the Commissioner of Patents, to be appointed by the President, by and with the advice and consent of the Senate, whose duty it shall be, under the direction of the Secretary of State, to superintend, execute, and perform, all such acts and things touching and respecting the granting and issuing of patents for new and useful discoveries, inventions, and improvements, as are herein provided for, or shall hereafter be, by law, directed to be done and performed, and shall have the charge and custody of all the books, records, papers, models, machines, and all other things belonging to said Office. And said Commissioner shall receive the same compensation as is allowed by law to the Commissioner of the Indian Department, and shall be entitled to send and receive letters and packages by mail, relating to the business of the office, free of postage.

SEC. 2. *And be it further enacted*, That there shall be, in said office, an inferior officer, to be appointed by the said principal officer, with the approval of the Secretary of State, to receive an annual salary of seventeen hundred dollars, and to be called the Chief Clerk of the Patent Office; who, in all cases during the necessary absence of the Commissioner, or when said principal office shall become vacant, shall have the charge and custody of the seal, and of the records, books, papers, machines, models, and all other things belonging to the said office, and shall perform the duties of Commissioner during such vacancy. And the said Commissioner may also, with like approval, appoint an examining clerk, at an annual salary of fifteen hundred dollars; two other clerks at twelve hundred dollars each, one of whom shall be a competent draughtsman; one other clerk at one thousand dollars; a machinist at twelve hundred and fifty dollars; and a messenger at seven hundred dollars. And said Commmissioner, clerks, and every other person appointed and employed in said office, shall be disqualified and interdicted from acquiring or taking, except by inheritance, during the period for which they shall hold their appointments, respectively, any right or interest, directly or indirectly, in any patent for an invention or discovery which has been, or may hereafter be, granted.

Sec. 3. *And be it further enacted*, That the said principal officer, and every other person to be appointed in the said office, shall, before he enters upon the duties of his office or appointment, make oath or affirmation, truly and faithfully to execute the trust committed to him. And the said Commissioner and the chief clerk shall also, before entering upon their duties, severally give bonds with sureties to the Treasurer of the United States, the former in the sum of ten thousand dollars, and the latter, in the sum of five thousand dollars, with condition to render a true and faithful account to him or his successor in office, quarterly, of all moneys which shall be by them respectively received for duties on patents, and for copies of records and drawings, and all other moneys received by virtue of said office.

Sec. 4. *And be it further enacted*, That the said Commissioner shall cause a seal to be made and provided for the said office, with such device as the President of the United States shall approve; and copies of any records, books, papers, or drawings, belonging to the said office, under the signature of the said Commissioner, or, when the office shall be vacant, under the signature of the chief clerk, with the said seal affixed, shall be competent evidence in all cases in which the original records, books, papers, or drawings, could be evidence. And any person making application therefor, may have certified copies of the records, drawings, and other papers deposited in said office, on paying, for the written copies, the sum of ten cents for every page of one hundred words; and for copies of drawings, the reasonable expense of making the same.

Sec. 5. *And be it further enacted*, That all patents issuing from said office shall be issued in the name of the United States, and under the seal of said office, and be signed by the Secretary of State, and countersigned by the Commissioner of said office, and shall be recorded, together with the descriptions, specifications, and drawings, in the said office, in books to be kept for that purpose. Every such patent shall contain a short description or title of the invention or discovery, correctly indicating its nature and design, and in its terms grant to the applicant or applicants, his or their heirs, administrators, executors, or assigns, for a term not exceeding fourteen years, the full and exclusive right and liberty of making, using, and vending to others to be used, the said invention or discovery, referring to the specifications for the particulars thereof, a copy of which shall be annexed to the patent, specifying what the patentee claims as his invention or discovery.

Sec. 6. *And be it further enacted*, That any person or persons having discovered or invented any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvement on any art, machine, manufacture, or composition of matter, not known or used by others before his or their discovery or invention thereof, and not, at the time of his application for a patent, in public use or on sale, with his consent or allowance, as the inventor or discoverer; and shall desire to obtain an exclusive property therein, may make application in writing to the Commissioner of Patents, expressing such desire, and the Commissioner, on due proceedings had, may grant a patent therefor. But before any inventor shall receive a patent for any such new invention or discovery, he shall deliver a written description of his invention or discovery, and of the manner and process of making, constructing, using, and compounding the same, in such full, clear, and exact terms, avoiding unnecessary prolixity, as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same;

and in case of any machine, he shall fully explain the principle and the several modes in which he has contemplated the application of that principle or character by which it may be distinguished from other inventions; and shall particularly specify and point out the part, improvement, or combination, which he claims as his own invention or discovery. He shall, furthermore, accompany the whole with a drawing, or drawings, and written references, where the nature of the case admits of drawings, or with specimens of ingredients, and of the composition of matter, sufficient in quantity for the purpose of experiment, where the invention or discovery is of a composition of matter; which descriptions and drawings, signed by the inventor and attested by two witnesses, shall be filed in the patent office; and he shall moreover furnish a model of his invention, in all cases which admit of a representation by model, of a convenient size to exhibit advantageously its several parts. The applicant shall also make oath or affirmation that he does verily believe that he is the original and first inventor or discoverer of the art, machine, composition, or improvement, for which he solicits a patent, and that he does not know or believe that the same was ever before known or used; and also of what country he is a citizen; which oath or affirmation may be made before any person authorized by law to administer oaths.

Sec. 7. *And be it further enacted*, That, on the filing of any such application, description, and specification, and the payment of the duty hereinafter provided, the Commissioner shall make or cause to be made, an examination of the alleged new invention or discovery; and if, on any such examination, it shall not appear to the Commissioner that the same had been invented or discovered by any other person in this country prior to the alleged invention or discovery thereof by the applicant, or that it had been patented or described in any printed publication in this or any foreign country, or had been in public use or on sale with the applicant's consent or allowance prior to the application, if the Commissioner shall deem it to be sufficiently useful and important, it shall be his duty to issue a patent therefor. But whenever, on such examination, it shall appear to the Commissioner that the applicant was not the original and first inventor or discoverer thereof, or that any part of that which is claimed as new had before been invented or discovered, or patented, or described in any printed publication in this or any foreign country, as aforesaid, or that the description is defective and insufficient, he shall notify the applicant thereof, giving him, briefly, such information and references as may be useful in judging of the propriety of renewing his application, or of altering his specification to embrace only that part of the invention or discovery which is new. In every such case, if the applicant shall elect to withdraw his application, relinquishing his claim to the model, he shall be entitled to receive back twenty dollars, part of the duty required by this act, on filing a notice in writing of such election in the Patent Office, a copy of which, certified by the Commissioner, shall be a sufficient warrant to the Treasurer for paying back to the said applicant the said sum of twenty dollars. But if the applicant in such case shall persist in his claim for a patent, with or without any alteration of his specification, he shall be required to make oath or affirmation anew, in manner as aforesaid. And if the specification and claim shall not have been so modified as, in the opinion of the Commissioner, shall entitle the applicant to a patent, he may, on appeal, and upon request in writing, have the decision of a board of examiners, to be composed of three disinterested persons, who shall be appointed for that purpose by the Secretary of State,

one of whom at least, to be selected, if practicable and convenient, for his knowledge and skill in the particular art, manufacture, or branch of science to which the alleged invention appertains; who shall be under oath or affirmation for the faithful and impartial performance of the duty imposed upon them by said appointment. Said board shall be furnished with a certificate in writing, of the opinion and decision of the Commissioner, stating the particular grounds of his objection, and the part or parts of the invention which he considers as not entitled to be patented. And the said board shall give reasonable notice to the applicant, as well as to the Commissioner, of the time and place of their meeting, that they may have an opportunity of furnishing them with such facts and evidence as they may deem necessary to a just decision; and it shall be the duty of the Commissioner to furnish to the board of examiners such information as he may possess relative to the matter under their consideration. And on an examination and consideration of the matter by such board, it shall be in their power, or of a majority of them, to reverse the decision of the Commissioner, either in whole or in part, and their opinion being certified to the Commissioner, he shall be governed thereby, in the further proceedings to be had on such application: *Provided, however*, That before a board shall be instituted in any such case, the applicant shall pay to the credit of the Treasury, as provided in the ninth section of this act, the sum of twenty-five dollars, and each of said persons so appointed shall be entitled to receive for his services in each case, a sum not exceeding ten dollars, to be determined and paid by the Commissioner out of any moneys in his hands, which shall be in full compensation to the persons who may be so appointed, for their examination and certificate as aforesaid.

Sec. 8. *And be it further enacted*, That whenever an application shall be made for a patent, which, in the opinion of the Commissioner, would interfere with any other patent for which an application may be pending, or with any unexpired patent, which shall have been granted, it shall be the duty of the Commissioner to give notice thereof to such applicants, or patentees, as the case may be; and if either shall be dissatisfied with the decision of the Commissioner on the question of priority of right or invention, on a hearing thereof, he may appeal from such decision, on the like terms and conditions as are provided in the preceding section of this act; and the like proceedings shall be had, to determine which or whether either of the applicants is entitled to receive a patent as prayed for. But nothing in this act contained shall be construed to deprive an original and true inventor of the right to a patent for his invention, by reason of his having previously taken out letters patent therefor in a foreign country, and the same having been published, at any time within six months next preceding the filing of his specification and drawing. And whenever the applicant shall request it, the patent shall take date from the time of the filing of the specification and drawings, not however exceeding six months prior to the actual issuing of the patent, and on like request, and the payment of the duty herein required, by any applicant, his specification and drawings shall be filed in the secret archives of the office until he shall furnish the model and the patent be issued, not exceeding the term of one year, the applicant being entitled to notice of interfering applications.

Sec. 9. *And be it further enacted*, That before any application for a patent shall be considered by the Commissioner as aforesaid, the applicant, shall pay into the Treasury of the United States, or into the Patent Office,

or into any of the deposite banks to the credit of the Treasury, if he be a citizen of the United States, or an alien, and shall have been a resident in the United States for one year next preceding, and shall have made oath of his intention to become a citizen thereof, the sum of thirty dollars; if a subject of the King of Great Britain, the sum of five hundred dollars; and all other persons the sum of three hundred dollars; for which payment duplicate receipts shall be taken, one of which to be filed in the office of the Treasurer. And the moneys received into the Treasury under this act, shall constitute a fund for the payment of the salaries of the officers and clerks herein provided for, and all other expenses of the Patent Office, and to be called the patent fund.

Sec. 10. *And be it further enacted*, That where any person hath made, or shall have made, any new invention, discovery, or improvement, on account of which a patent might by virtue of this act be granted, and such person shall die before any patent shall be granted therefor, the right of applying for and obtaining such patent shall devolve on the executor or administrator of such person, in trust for the heirs at law of the deceased, in case he shall have died intestate; but if otherwise, then in trust for his devices, in as full and ample manner, and under the same conditions, limitations, and restrictions, as the same was held, or might have been claimed or enjoyed by such person in his or her lifetime; and when application for a patent shall be made by such legal representatives, the oath or affirmation provided in the sixth section of this act, shall be so varied as to be applicable to them.

Sec. 11. *And be it further enacted*, That every patent shall be assignable in law, either as to the whole interest, or any undivided part thereof, by any instrument in writing; which assignment, and also every grant and conveyance of the exclusive right under any patent, to make and use, and to grant to others to make and use, the thing patented within and throughout any specified part or portion of the United States, shall be recorded in the Patent Office within three months from the execution thereof, for which the assignee or grantee shall pay to the Commissioner the sum of three dollars.

Sec. 12. *And be it further enacted*, That any citizen of the United States, or alien, who shall have been a resident in the United States one year next preceding, and shall have made oath of his intention to become a citizen thereof, who shall have invented any new art, machine, or improvement thereof, and shall desire further time to mature the same, may, on paying to the credit of the Treasury, in manner as provided in the ninth section of this act, the sum of twenty dollars, file in the Patent Office a caveat, setting forth the design and purpose thereof, and its principal and distinguishing characteristics, and praying protection of his right, till he shall have matured his invention; which sum of twenty dollars, in case the person filing such caveat shall afterwards take out a patent for the invention therein mentioned, shall be considered a part of the sum herein required for the same. And such caveat shall be filed in the confidential archives of the office, and preserved in secrecy. And if application shall be made by any other person within one year from the time of filing such caveat, for a patent of any invention with which it may in any respect interfere, it shall be the duty of the Commissioner to deposite the description, specifications, drawings, and model, in the confidential archives of the office, and to give notice, by mail, to the person filing the caveat, of such application, who shall, within three months after receiving the notice, if he would avail himself of the benefit of his caveat, file his description, specifications, drawings,

and model; and if, in the opinion of the Commissioner, the specifications of claim interfere with each other, like proceedings may be had in all respects as are in this act provided in the case of interfering applications: *Provided, however*, That no opinion or decision of any board of examiners, under the provisions of this act, shall preclude any person interested in favor of or against the validity of any patent which has been or may hereafter be granted, from the right to contest the same in any judicial court in any action in which its validity may come in question.

Sec. 13. *And be it further enacted*, That whenever any patent which has heretofore been granted, or which shall hereafter be granted, shall be inoperative or invalid, by reason of a defective or insufficient description or specification, or by reason of the patentee claiming in his specification as his own invention, more than he had or shall have a right to claim as new, if the error has, or shall have arisen by inadvertency, accident, or mistake, and without any fraudulent or deceptive intention, it shall be lawful for the Commissioner, upon the surrender to him of such patent, and the payment of the further duty of fifteen dollars, to cause a new patent to be issued to the said inventor, for the same invention, for the residue of the period then unexpired for which the original patent was granted, in accordance with the patentee's corrected description and specification. And in case of his death, or any assignment by him made of the original patent, a similar right shall vest in his executors, administrators, or assignees. And the patent so reissued, together with the corrected description and specification, shall have the same effect and operation in law, on the trial of all actions hereafter commenced for causes subsequently accruing, as though the same had been originally filed in such corrected form, before the issuing of the original patent. And whenever the original patentee shall be desirous of adding the description and specification of any new improvement of the original invention or discovery which shall have been invented or discovered by him subsequent to the date of his patent, he may, like proceedings being had in all respects as in the case of original applications, and on the payment of fifteen dollars, as hereinbefore provided, have the same annexed to the original description and specification; and the Commissioner shall certify, on the margin of such annexed description and specification, the time of its being annexed and recorded; and the same shall thereafter have the same effect in law, to all intents and purposes as though it had been embraced in the original description and specification.

Sec. 14. *And be it further enacted*, That whenever, in any action for damages for making, using, or selling the thing whereof the exclusive right is secured by any patent heretofore granted, or by any patent which may hereafter be granted, a verdict shall be rendered for the plaintiff in such action, it shall be in the power of the court to render judgment for any sum above the amount found by such verdict as the actual damages sustained by the plaintiff, not exceeding three times the amount thereof, according to the circumstances of the case, with costs; and such damages may be recovered by action on the case, in any court of competent jurisdiction, to be brought in the name or names of the person or persons interested, whether as patentee, assignees, or as grantees of the exclusive right within and throughout a specified part of the United States.

Sec. 15. *And be it further enacted*, That the defendant in any such action shall be permitted to plead the general issue, and to give this act and any special matter in evidence, of which notice in writing may have been given to the plaintiff or his attorney, thirty days before trial, tending to

prove that the description and specification filed by plaintiff does not contain the whole truth relative to his invention or discovery, or that it contains more than is necessary to produce the described effect; which concealment or addition shall fully appear to have been made for the purpose of deceiving the public, or that the patentee was not the original and first inventor or discoverer of the thing patented, or of a substantial or material part thereof claimed as new, or that it had been described in some public work anterior to the supposed discovery thereof by the patentee, or had been in public use, or on sale with the consent and allowance of the patentee before his application for a patent, or that he had surreptitiously or unjustly obtained the patent for that which was in fact invented or discovered by another, who was using reasonable diligence in adapting and perfecting the same; or that the patentee, if an alien at the time the patent was granted, had failed and neglected for the space of eighteen months from the date of the patent, to put and continue on sale to the public, on reasonable terms, the invention or discovery for which the patent was issued; in either of which cases judgment shall be rendered for the defendant, with costs. And whenever the defendant relies in his defence on the fact of a previous invention, knowledge, or use of the thing patented, he shall state, in his notice of special matter, the names and places of residence of those whom he intends to prove to have possessed a prior knowledge of the thing, and where the same had been used: *Provided, however,* That whenever it shall satisfactorily appear that the patentee, at the time of making his application for the patent, believed himself to be the first inventor or discoverer of the thing patented, the same shall not be held to be void on account of the invention or discovery or any part thereof having been before known or used in any foreign country, it not appearing that the same or any substantial part thereof had before been patented or described in any printed publication. *And provided, also,* That whenever the plaintiff shall fail to sustain his action on the ground that in his specification of claim is embraced more than that of which he was the first inventor, if it shall appear that the defendant had used or violated any part of the invention justly and truly specified and claimed as new, it shall be in the power of the court to adjudge and award as to costs as may appear to be just and equitable.

Sec. 16. *And be it further enacted,* That whenever there shall be two interfering patents, or whenever a patent on application shall have been refused on an adverse decision of a board of examiners, on the ground that the patent applied for would interfere with an unexpired patent previously granted, any person interested in any such patent either by assignment or otherwise, in the one case, and any such applicant in the other case, may have remedy by bill in equity; and the court having cognizance thereof, on notice to adverse parties and other due proceedings had, may adjudge and declare either the patents void in the whole or in part, or inoperative and invalid in any particular part or portion of the United States, according to the interest which the parties to such suit may possess in the patent or the inventions patented, and may also adjudge that such applicant is entitled, according to the principles and provisions of this act, to have and receive a patent for his invention, as specified in his claim, or for any part thereof, as the fact of priority of right or invention, shall in any such case be made to appear. And such adjudication, if it be in favor of the right of such applicant, shall authorize the Commissioner to issue such patent, on his filing a copy of the adjudication, and otherwise complying with the requisitions of this act. *Provided, however,* That no such judgment or adjudication shall affect

the rights of any person except the parties to the action and those deriving title from or under them, subsequent to the rendition of such judgment.

Sec. 17. *And be it further enacted*, That all actions, suits, controversies, and cases arising under any law of the United States, granting or confirming to inventors the exclusive right to their inventions or discoveries, shall be originally cognizable, as well in equity as at law, by the circuit courts of the United States, or any district court, having the powers and jurisdiction of a circuit court; which courts shall have power upon bill in equity, filed by any party aggrieved, in any such case, to grant injunctions, according to the course and principles of courts of equity, to prevent the violation of the rights of any inventor as secured to him by any law of the United States, on such terms and conditions as said courts may deem reasonable: *Provided, however*, That from all judgments and decrees, from any such court, rendered in the premises, a writ of error or appeal, as the case may require, shall lie to the Supreme Court of the United States, in the same manner and under the same circumstances as is now provided by law, in other judgments and decrees of circuit courts, and in all other cases in which the court shall deem it reasonable to allow the same.

Sec. 18. *And be it further enacted*, That whenever any patentee of an invention or discovery shall desire an extension of his patent beyond the term of its limitation, he may make application therefor, in writing to the Commissioner of the Patent Office, setting forth the grounds thereof; and the Commissioner shall, on the applicant's paying the sum of forty dollars to the credit of the Treasury, as in the case of an original application for a patent, cause to be published, in one or more of the principal newspapers in the city of Washington, and in such other paper or papers as he may deem proper, published in the section of country most interested adversely to the extension of the patent, a notice of such application and of the time and place, when and where the same will be considered, that any person may appear and show cause why the extension should not be granted. And the Secretary of State, the Commissioner of the Patent Office, and the Solicitor of the Treasury, shall constitute a board to hear and decide upon the evidence produced before them both for and against the extension, and shall sit for that purpose at the time and place designated in the published notice thereof. The patentee shall furnish to said board a statement, in writing, under oath, of the ascertained value of the invention, and of his receipts and expenditures, sufficiently in detail to exhibit a true and faithful account of loss and profit in any manner accruing to him from and by reason of said invention. And if, upon a hearing of the matter, it shall appear to the full and entire satisfaction of said board, having due regard to the public interest therein, that it is just and proper that the term of the patent should be extended, by reason of the patentee, without neglect or fault on his part, having failed to obtain, from the use and sale of his invention, a reasonable remuneration for the time, ingenuity, and expense bestowed upon the same, and the introduction thereof into use, it shall be the duty of the Commissioner to renew and extend the patent, by making a certificate thereon of such extension, for the term of seven years, from and after the expiration of the first term; which certificate, with a certificate of said board of their judgment and opinion as aforesaid, shall be entered on record in the Patent Office; and thereupon the said patent shall have the same effect in law as though it had been originally granted for the term of twenty-one years. And the benefit of such renewal shall extend to assignees and grantees of the right to use the thing patented, to the extent of their

respective interest therein: *Provided, however,* That no extension of a patent shall be granted after the expiration of the term for which it was originally issued.

Sec. 19. *And be it further enacted,* That there shall be provided for the use of said office, a library of scientific works and periodical publications both foreign and American, calculated to facilitate the discharge of the duties hereby required of the chief officers therein, to be purchased under the direction of the Committee of the Library of Congress. And the sum of fifteen hundred dollars is hereby appropriated for that purpose, to be paid out of the patent fund.

Sec. 20. *And be it further enacted,* That it shall be the duty of the Commissioner to cause to be classified and arranged, in such rooms or galleries as may be provided for that purpose, in suitable cases, when necessary for their preservation, and in such manner as shall be conducive to a beneficial and favorable display thereof, the models and specimens of compositions and of fabrics and other manufactures and works of art, patented or unpatented, which have been, or shall hereafter be deposited in said office. And said rooms or galleries shall be kept open during suitable hours for public inspection.

Sec. 21. *And be it further enacted,* That all acts and parts of acts heretofore passed on this subject, be, and the same are hereby repealed: *Provided, however,* That all actions and processes in law or equity sued out prior to the passage of this act, may be prosecuted to final judgment and execution, in the same manner as though this act had not been passed, excepting and saving the application to any such action, of the provisions of the fourteenth and fifteenth sections of this act, so far as they may be applicable thereto. *And provided, also,* That all applications or petitions for patents, pending at the time of the passage of this act, in cases where the duty has been paid, shall be proceeded with and acted on in the same manner as though filed after the passage thereof.

James K. Polk,
Speaker of the House of Representatives.
W. R. King,
President of the Senate, pro tempore.

Approved, July 4th, 1836.
Andrew Jackson.

Physical Science.

History of experiments on atmospheric electricity, being a report presented by a Committee of the "Franklin Kite Club," at the request of the Club.*

The Committee appointed to enquire into the history of experiments, upon the electricity of the atmosphere; having given such attention to the subject as their other engagements would allow: beg leave to submit the following report:

The fact that amber and some gems, when excited by friction, possessed the curious property of attracting light bodies; was known to philosophers several centuries before the christian era. Nothing further, however,

* John C. Cresson, Esq. Chairman.

than this simple fact, seems to have been ascertained for the space of two thousand years.

The first modern experiments upon record were those of Dr. Gilbert of Colchester, an account of which he published about the year 1600, in a treatise de magnete. Although several philosophers repeated the experiments of Gilbert, and somewhat augmented the list of electric substances, no discovery of importance was effected until about the year 1670, at which period Otto Guericke, celebrated as the inventor of the air pump, constructed the first electrical machine of which we have any account, and acquired an additional title to renown, by discovering the light and sound by which the electric fluid is accompanied.

The existence of electric light was observed shortly afterwards in England, by Dr. Wall, to whom also is due the honor of first suggesting the idea of a resemblance between electricity and lightning.

This resemblance was afterwards noticed by Mr. Stephen Gray, who flourished about the year 1730; and still later by the Abbe Nollet; but neither of them appears to have attempted any investigation of the subject. The complete solution of this interesting problem in electrical science was reserved for our venerated countryman, Franklin; who at an early period of his investigations, became strongly impressed with the idea that lightning and electricity were identical. He accordingly drew up a statement of the principal points of resemblance between them, and suggested a plan for proving the truth of his theory, by elevating pointed conductors upon a lofty tower or spire. This paper, together with several others upon the same subject, he transmitted to his friend Mr. Collinson of London, by whom they were communicated to the Royal Society.

The reception which these essays met with in that learned body was by no means flattering, as will be perceived from the following extract from Franklin's Memoirs. "Obliged as we were to Mr. Collinson, for the present of the tube, &c., I thought it right he should be informed of our success in using it, and wrote him several letters containing accounts of our experiments. He got them read in the Royal Society, where they were not at first thought worthy of so much notice as to be printed among their transactions. One paper which I wrote for Mr. Kinnersly, on the sameness of lightning and electricity was read, but was laughed at by the connoiseurs." The papers being afterwards shown to Dr. Fothergill, he thought them of too much importance to be stifled, and advised the printing of them. They were accordingly published in a pamphlet form by Cave, a bookseller in London, with a preface by Dr. Fothergill. A copy of this pamphlet happening to fall into the hands of Buffon the naturalist, this eminent philosopher was so well satisfied of the justness of Franklin's views, that he determined on making the attempt to draw down lightning from the clouds. Accordingly, he raised an insulated rod of iron upon the tower of Montbar, and prevailed upon M. D'Alibard, to prepare an apparatus for the same purpose at Marly La Ville, about six miles from Paris. This apparatus consisted of a pointed iron rod, about forty feet long and an inch in diameter, the lower extremity of which was brought into a sentry box and insulated upon a table with glass feet. M. D'Alibard entrusted the charge of his apparatus to a man named Coiffier, who having served fourteen years in the dragoons, was supposed to have sufficient courage for such an undertaking.

We have been thus particular in our description of this machine, because it was the first to receive a visit from the ethereal fire; and shall now pro-

ceed to give a narrative of that important event, extracted from a paper laid before the Royal Academy of Science, at Paris, three days after the occurrence. "On Wednesday, the 10th of May, 1752, between two and three o'clock in the afternoon, M. Coiffier, an old dragoon, whom I had entrusted to make observations in my absence, hearing a pretty loud clap of thunder immediately flies to the machine, taking with him a vial in which was fixed a brass wire; on presenting the point of the wire to the rod he sees a small brilliant spark issue from it, and hears a crackling noise; he takes a second spark stronger than the first and with a louder noise! He call his neighbors and sends for M. Raulet, the Prior of Marly. The Prior runs with all his might, and the parishioners seeing his haste imagine that poor Coiffier had been killed by the thunder; the alarm spread throughout the village, and the hail which succeeded did not prevent them from following their Pastor.

The honest ecclesiastic arrived at the machine, and seeing there was no danger, tries the experiment himself, and takes some strong sparks. The hail storm was not more than a quarter of an hour in passing the zenith of our machine and there was no more thunder after the first clap." As soon as the cloud had passed and they could get no more sparks from the rod, the Prior despatched M. Coiffier with the following hasty letter.

"I announce to you sir, the fulfilment of your expectations: the experiment is complete. This day, at twenty minutes after two in the afternoon, it thundered directly over Marly, the clap was pretty loud. The desire to please you, and curiosity, induced me at once to quit my arm chair, in which I was engaged reading. I was hastening to M. Coiffier, and met on the road a child whom he had despatched to call me, I redoubled my speed through a torrent of hail. Arriving at the spot where the rod was placed, I took a brass wire and advancing it towards the rod, when within about an inch and a half, a small column of blueish flame with a smell like sulphur, sprung with wonderful quickness to the point of the wire, and occasioned a noise as if the rod had been struck with a key. I repeated the experiment at least six times in about five minutes, each experiment requiring about the time of a Pater and an Ave. I wished to continue them but the action of the fire gradually abated, and at length ceased altogether. The stroke of thunder which had occasioned this event was not followed by any other and the whole was terminated by a copious shower of hail.

I was so engaged during the experiment, that receiving a blow upon my arm above the elbow, I could not tell whether it proceeded from the brass wire or the rod. I did not complain at the moment, but the pain continuing on returning home, I uncovered my arm in the presence of Coiffier, and we perceived a contusion around it, such as would be caused by a blow from the wire upon the bare skin. When returning with Coiffier, I met the Curate, M. de Milley and the schoolmaster, to whom I reported what had happened. They all three perceived a smell of sulphur, which increased as they approached me: this odour was also perceived by the servants before I said any thing to them about it.

You have here, sir, a hasty recital, but it is correct and true, and I assure you that I am prepared to testify to these facts on all occasions. Coiffier was the first to make the experiment, and he repeated it several times before he sent for me. If any other testimony besides his and mine is necessary you can obtain it. Coiffier is in haste to depart. I am yours with respectful consideration. RAULET, *Prior of Marly*."

May 10, 1753.

Immediately upon the announcement of M. D'Alibard's success, M. Delor demonstrator of physick, at Paris, erected a bar of iron upon his dwelling for the purpose of repeating the experiment, and succeeded in procuring several sparks during a thunder storm on the 18th day of May. On the 19th of the same month, Buffon obtained a similar result at Montbar.

Thus was Franklin's hypothesis verified in Europe, while its illustrious author was waiting for the erection of a spire at Philadelphia, by which he should be enabled to reach what he supposed to be the proper region for experiment. At length he devised the simple expedient of using a common kite for the attainment of his object, and in June, 1752, about a month after the French discoveries, but before any report of them had reached America, he performed his celebrated experiment.

Although it may seem unnecessary to repeat in this place a narrative with which every school boy is familiar, we shall, nevertheless, annex an account of this famous experiment, believing the omission would leave our report defective in a very essential point. The kite used by Franklin on this occasion, was made by extending a silk handkerchief upon two crossed sticks. To the upright stick was affixed an iron point.

The string was of hemp, except a small portion of the lower end, which was of silk: where the hempen string terminated a key was fastened. With this apparatus, on the approach of a thunder storm, he repaired to an open field accompanied by his son, to whom alone he had communicated his intention.

Having raised his kite, he placed himself under a shed, to avoid the rain and preserve the insulation of his silk cord. A thunder cloud passed over the kite and no sign of electricity appeared. When, almost despairing of success, he observed the loose fibres of the string become erect as if they were repelled. He now presented his knuckle to the key and received a strong spark; others succeeded even before the string was wet; but when the string was thoroughly wetted by the rain, he collected the electric fire in great abundance.

Franklin afterwards erected an insulated rod upon his house, by means of which he continued to investigate the subject for several years, in conjunction with his friend Mr. Kinnersly. The new field of discovery thus opened to the votaries of science, was speedily entered by a host of experimenters. Of these, it will be necessary to name only a few of the more prominent, whose experiments and discoveries embrace all that it is interesting to know.

In England, the first attempts to repeat these experiments, were made by Mr. Canton and Dr. Bevis; but owing to the unfavorable nature of the climate, or some defect in their apparatus, it was not until after numerous disappointments that they succeeded in obtaining some feeble indication of electricity. The most splendid experiments that have come under the notice of the Committee, were those made in France by M. De Romas, assessor of the Presidial of Nerac.* This gentleman made use of a kite which was seven feet five inches in height, and three feet in its greatest width, having above eighteen square feet of surface. The string was wrapped with copper wire somewhat after the manner of the base string of a violin.

On the 7th of June, 1753, at one o'clock, it thundered in the west; at

* A full account of these experiments may be found in the Memoirs de Savans Etrangers, published by the French Academy.

half past two M. De Romas, had raised his kite with a cord 780 feet long, inclined at an angle of 45° nearly; so that the elevation of the kite was about 550 feet. To the lower end of the cord he tied a ribbon of silk about three and a half feet long; this was brought under cover of a pent house and was there fastened to a heavy stone. Near the junction of the cord and ribbon was suspended a tube of tin one foot long and an inch in diameter, from which the sparks were to be drawn.

He had prepared a discharging rod with a glass handle twelve inches long, and provided with a brass chain of sufficient length to touch the ground when sparks were drawn from the tube. By means of the discharging rod he at first obtained sparks as large as those produced by a good globe, and several of his assistants drew sparks with keys and with the naked finger. This performance continued about twenty-two minutes, when the electricity disappeared; the little black clouds from which it was procured having passed from the zenith of the kite. In about seven minutes the electricity re-appeared, but was at first very feeble; it gradually increased, and sparks were drawn by the fingers, canes, and swords, of the spectators. M. De Romas now touched the tube with his knuckle, and received a terrible shock, such as he had never experienced from the Leyden vial charged by the best globes. Seven or eight of the bystanders having joined hands received sparks which struck the feet of the fifth person. The storm now approached and increased in violence, not a drop of rain had fallen; but in the zenith of the kite and about 60° around it, there were black clouds, which indicated a great increase of electricity.

M. De Romas therefore, thought proper to receive sparks only by the discharge; and in this manner drew several sparks more than two inches long and of proportionate thickness. After this, the electricity became so strong, that instead of sparks sheets of fire three inches long and three lines in diameter, flashed to the distance of more than a foot from the tube. At this time, when about three feet from the cord, he felt a sensation as if a spider's web was upon his face. He advised his assistants to keep at a greater distance, and himself retired about two feet; and when five feet from the cord, he again perceived the same sensation and retired still further. M. De Romas now paused to observe what took place in the clouds above the kite; there was no lightning, almost no thunder, and not any rain, the wind was west and so strong that the kite rose about 100 feet higher than at first. Having cast his eyes upon the tin tube which was about three feet from the ground; he observed three straws about a foot long, and others four and five inches in length, standing erect upon the ground and dancing in a ring beneath the tube like puppets. This little spectacle lasted about fifteen minutes, after which some drops of rain fell and he again felt the spider web sensation, and heard a rustling noise like the sound of a small forge bellows. This was considered a warning of a new increase of electricity, and he cautioned his assistants to retire to a greater distance. Now came the last act of this magnificent drama, which M. De Romas says made him tremble. The longest straw was attracted by the tube, and then followed an explosion which some compared to the noise of a petard, and others to the sound of a large earthen jar dashed upon a pavement. The fire which accompanied this explosion had the form of a spindle eight inches long and four or five lines in diameter. The straw which had caused the explosion followed the string of the kite and was seen at the distance of forty or fifty toises going with great rapidity, alternately attracted and repelled, every attraction being accompanied by sheets of fire

and continual explosions. During this part of the exhibition there was a strong smell of sulphur, and around the string there appeared a cylinder of permanent light three or four inches in diameter; which, it was supposed, would have appeared to be four or five feet in diameter if the experiment had been made at night. Shortly after this the wind shifted to the east and the rain fell abundantly, followed by some hail, so that they were unable to keep the kite up any longer; as it fell the string came in contact with a roof; the kite was made to rise again, and as soon as it was released from the roof the person who held the string received such a violent blow in his hands that he was compelled to relinquish it. The string now became slack and falling upon the feet of one of the assistants, he felt a concussion almost insupportable. On the 16th of August, 1757, M. De Romas, having again raised his kite with a cord more than 1000 feet in length, obtained results even more astonishing than those just narrated.

In a letter to the Abbé Nollet, giving an account of this experiment, he says, "imagine to yourself sheets of fire nine or ten feet in length, and one inch in diameter, with a noise like the report of a pistol: in less than an hour I had certainly thirty flashes of these dimensions without counting a thousand others of seven feet and under."

The dangerous nature of these experiments was fearfully illustrated about this time, by an accident which created a deep sensation throughout the scientific world. Prof. Richman, of St. Petersburgh, being engaged in a treatise upon electricity, had erected upon his house an apparatus for observing the electrical condition of the atmosphere, during thunder storms. On the 6th of August, 1753, while attending the usual meeting of the Imperial Academy of Sciences, a little before noon he heard the sound of distant thunder, and hastened home accompanied by Mr. Sokolow, engraver to the Academy. Upon examining the electrometer which was attached to his apparatus, Richman remarked that the thread pointed to four degrees on the quadrant; and described to Mr. Sokolow, the dangerous consequences that might ensue if the electricity should increase to 45° or more. At this moment while Mr. Richman was in a stooping posture with his head about a foot distant from the rod, a globe of white and blue fire about the size of a man's fist appeared between the machine and Mr. Richman's head. At the same time a sort of steam or vapour arose which stupefied the engraver and made him sink down, so that he could not remember to have heard the thunder which was very loud.

As soon as Mrs. Richman heard the loud clap of thunder she hastened to her husband's chamber, fearful of some bad consequences, and found him entirely lifeless, sitting upon a chest which happened to be placed behind him, and leaning against the wall.

After this unfortunate occurrence, electricians became more circumspect in experimenting upon an agent so dangerous and intractable. The phenomena of thunder storms having been investigated to a considerable extent, philosophers next directed their attention to observations upon the ordinary electrical condition of the atmosphere and the changes to which it is subject. Experiments of this kind were prosecuted in America, by Mr. Kennersley, the friend and associate of Franklin; in France by M. Le Monnier, and the Abbé Mazeas; in Switzerland by M. De Saussure; and in England by Mr. Cavallo, Mr. Read, and several others. But the labours of these philosophers although of great value and interest, fall very far short of those achieved by Signior Beccaria, of Turin; who continued a series of accurate experiments through a period of twenty years.

The observations of this eminent philosopher, were made in all kinds of weather and every season of the year. He made use of a great variety of instruments, and employed numerous assistants, sometimes causing simultaneous observations to be made at several distant places. As the limits of this report will not allow a detailed account of the phenomena observed by all these philosophers, it is deemed advisable to furnish a condensed statement of the general results, upon which most of the observers agree in a very satisfactory manner.

In calm, clear, dry weather, the electricity was always perceptible and invariably positive. It was more abondant in winter than in summer. During a rain it was generally negative, but it sometimes became positive while the rain was falling; and on some occasions these changes occurred several times in the course of a single storm.

In cloudy, damp, or windy weather, it was mostly positive but feeble. The quantity always increased with the length and elevation of the conductor; insulated strings extended horizontally, sometimes gave strong indications of electricity; a cord 1,500 Paris feet in length, extended across the river Po, was found to be as strongly electrified during a shower unattended by thunder, as a rod of metal had been during a thunder storm.

The latest of these experiments were made about the year 1791; since which period the interesting phenomena brought to light by the discovery of galvanism, have so much engrossed the attention of philosophers, that the other branches of electrical science have been comparatively neglected.

As far as the committee have been able to extend their researches, it appears that the observers of atmospheric electricity, have confined their experiments to a region of comparatively very small elevation, none of them having attained a greater distance from the surface of the earth, than one thousand feet; and even the few who reached this height, made use of such imperfect conductors, as were not calculated to furnish accurate results. It therefore seems probable, that a course of experiments made with good conductors elevated to the height of ten or fifteen thousand feet, would furnish such an addition to our knowledge of this interesting subject, as would fully compensate the labour and expense necessary for their prosecution.

Notice of the "Report on the new map of Maryland, 1835."

To the Editor of the Journal of the Franklin Institute.

Sir:—I send to you for insertion in the Journal of the Franklin Institute, a notice of the report of the gentlemen appointed under a law of Maryland, to make a Topographical and Geological survey of that state. The examination has manifestly been confided to able hands, and I think sir, that you will concur with me in the conclusion that the course adopted by Prof. Ducatel, in devoting so large a portion of investigations and observations in the first instance, to those deposits and formations which may be at once available by the cultivator of the soil, is, in every point of view, most judicious.

The state of Maryland has been among the first of the Union to adopt the liberal and enlightened policy, which there is now good ground to hope will become general. The report for 1835, is the third which has been made since the commencement of the survey of Maryland, and it will be seen that she will be in possession of an exact description of her surface, topographically as well as an examination into the constituents of her soil geologically, by which her resources will be developed, and her geographical limits and positions be determined. The construction of her new topographical and

geological map was commenced, and has been continued under the direction of J. H. Alexander, Esq. and Prof. J. T. Ducatel of the University of Maryland, the former having charge of the topographical, and the latter the geographical department. The report whose title stands at the head of this notice, was submitted to the Governor of the state during the last winter, and embraces a detail of the progress of the work during last year. It exhibits industry and intelligence, combined with the requisite scientific attainments for an exact and useful survey, and does credit to the already well established characters of the gentlemen engaged in its execution. The report is divided into two separate and distinct papers, each emanating from the respective officers, and treating exclusively of the matters peculiarly referred to his charge. That of the topographer, is chiefly occupied with details of local surveys, to which his attention had been especially directed by resolutions of the legislature, relative to the opening of new avenues of internal communication, the draining of marshes, &c. &c. and although it may possess but little to attract the general reader, it is interesting in the highest degree to the citizens of Maryland. The grand trigonometrical survey of the state has also occupied his attention, and details are exhibited showing its progress, under the advice of the chief of the United States Coast Survey, in connexion with which, this work is designed to be executed;—reciprocal benefits being anticipated from this mode of prosecuting the work. Several well executed lithographic maps accompany the report, illustrating particular portions of it. The concluding pages of the report recommending the establishment of a state observatory is particularly deserving of general perusal; the cause of science, and of public utility, would be promoted by a general attention to the following considerations presented in their remarks on that subject.

"After what has been said, the undersigned might terminate here his report, where it not that an object of great interest remains still to be submitted to your Excellency. This is a provision for the erection of a *State Observatory*. Although not indispensably necessary for the proper completion of the trigonometrical survey, it would furnish great and evident assistance, and would be found to increase in utility and value in proportion as the establishment itself grew older, long after the period when the labours of that survey shall have been closed. The fact of the importance of astronomical observations in one place, under the same circumstances, with assured regularity, and in a proper series, need not be adverted to here. The first advances towards civilization and the sciences were in the rude attempts to collect and classify knowledge in this particular—their latest acmé will be illustrated by the efforts and success in its pursuit. Already, in Europe, the *moral force* of a government is estimated by what is done under its auspices to enlarge the sphere of acquaintance with facts: and if for us the prosperity of the present is no inducement, a pledge of the gratitude of the future is found in the affectionate reverence with which the memory of those especially, who in this branch toiled, under greater disadvantages, for the promotion of the very object here recommended.

The Undersigned solicits, then, the particular attention of your Excellency and of the General Assembly, to this proposition. He asks for it no more aid, of course, than its intrinsic worth seems to deserve: but it appears to him that, to every one who will take the trouble to make the comparison, the contrast between the amount expended and benefits gained will be very striking. Not many hundred dollars would be required to arrange the necessary apparatus, with the conveniences, for its earliest trials. The fruits

of ten years' labour in that observatory would *sell* (if it is to keep a profit and loss account,) for five times so much—at the same time that it is exercising a moral influence incalculably more valuable.

The fact, that in this country there has been as yet no establishment of this kind, and that extensively indebted as our commerce is to the laborious investigations and observations of citizens and governments abroad, no effort has yet been made towards repayment, appears to offer strong grounds for the measure; and the present crisis seems not unfavourable for its execution. It may be added, that by no member of our national confederacy can the step be with more propriety taken than by Maryland; who has already, within late years, done so much by a discreet liberality to foster not only the researches of pure science, but that happier union of science and enterprize, which alone will render the one valuable—the other not unavailing."

A better index to what has been done by the geologist during the same period cannot, perhaps be furnished than by inserting the following extract from the report itself.

"It will be remembered that the final intention of the survey is, to furnish to the officer now engaged in preparing a topographical and geographical map of the state, on the accomplishment of his work, with a complete and minute geological account of the whole state, which will enable him to indicate upon the new map the localities of valuable mineral deposites, as well as to exhibit correctly, the limits of the different geological formations, that compose the territory of Maryland. Accordingly, the undersigned has never lost sight of this final object of his investigations, so that it has been his constant care to collect as much information in this respect as possible: and he flatters himself that he has succeeded in acquiring all the knowledge desirable, of such portions of the state as have been already traversed, and over which geological surveys have been completed. But it cannot be expected of him to make those results fully known at present, because there remains another important step to be taken, namely: to connect the results of observations made in one section of the country, with those in another; by which many generalities of consequence may be extended, corrected, improved, or modified. It is not necessary to be conversant with the subject, to perceive the necessity of becoming well acquainted with every part of a system of formations, before any comprehensive description of such a system can be given. Nor has it been in the power of the geologist, to adopt and pursue such a plan of operations more in accordance than the one he has followed, with this apparently most desirable mode of proceeding; his instructions having been virtually, to cause the strict demands of science to yield to the paramount considerations of public favour and utility. Hence it has not unfrequently happened, that whilst pursuing with great personal interest, a series of observations, a sense of public duty, and a desire to render more immediately available some important suggestion, have compelled him to obey calls upon him to set on foot new inquiries in other districts. Thus, whilst endeavouring to determine the exact limits of the three tertiary periods that occur within our territory, and partly extend over both shores of the Chesapeake bay, having received specimens of a valuable material, forming part of the secondary formations, it was deemed advisable to repair to this new field of interest, to expedite the benefit that might be derived from the discovery: some advantage being moreover expected, by directing the researches of those interested in it, preparatory to the future more minute investigations."

The report appears fully to establish the existence of green land of the age of the New Jersey marl, in Kent and Cecil counties, and intimates that some of the members of the same formation have been discovered in the Potomac counties.

In the belief that the legislature which ordered the survey designed it as the means for developing all the advantages and riches of the state for the benefit of every portion of her population, the geologist in prosecuting his labours, has endeavoured to embrace in his report every prominent consideration of practical utility immediately or remotely applicable, to the various interests of his fellow citizens.

In accordance with this understanding of his duties, he has laboured and it would seem successfully, in demonstrating to the agriculturists of Maryland, that they have within their reach the means of fertilizing and improving their soil to any desirable extent. Shell marl, green sand, oyster shell lime, are all readily attainable in their respective localities, whilst the unusual facilities of transportation afforded by the Chesapeake Bay and its numerous tributaries and inlets, afford to the farmers of both its shores, advantages, which are seldom equalled, and probably nowhere surpassed.

The cultivators of the soil are, it is said, already beginning to avail themselves of what has been pointed out in the former reports, and, if so, their practical experience will soon corroborate the scientific intelligence, which pointed out to them the sources of abundance and wealth so directly at their command.

One whole chapter of the report is occupied with considerations upon the agricultural resources of the lower counties, which is too voluminous for insertion in your pages; I therefore extract the following very interesting summary of them, intended by the author to direct the attention of his fellow citizens to the greater advantages which present themselves in their own fair territory, than may be found in the "far west" whither the restless spirit of emigration is fast hurrying a great amount of the population.

"Such are the agricultural resources of the lower counties on the eastern shore of Maryland, so far as the productiveness of the soil, and its susceptibility of improvement are concerned. It has already been stated, that the only incidental resource possessed by this section of country, is to be derived from the facilities of obtaining calcareous matter (in which the soil is essentially deficient) from the shell banks, oyster banks, and other sources already referred to. But before any hope can be indulged, that the inhabitants of this portion of the state will avail themselves of these means of bringing their lands into a higher state of cultivation than they seem to have any idea that they are capable of, it is necessary to remove a fatal impression, too generally made, that the lime derived from shells is of but little value. The result of the inquiries made to disprove this opinion, will be given in the next section of this report.

An error equally fatal prevails among the citizens of Maryland, in reference to the counties that have just been passed in review,—that they are as devoid of interest as they have been believed to be of resources. It is hoped that the minute, and, at the same time, faithful account given of them—more minute than would otherwise have seemed necessary—will have a tendency to rectify the false judgment so commonly passed upon this portion of our territory, and contribute likewise to cheer those of its inhabitants who have become disheartened at the present aspect of things, and who are too prone to believe that their industry could be better rewarded at a distance."

The immense heaps of oyster shells, furnishing vast supplies of lime, has induced Prof. Ducatel to devote an entire chapter, to a comparison of the value of shell and stone lime—an opinion prevalent among Maryland farmers that the former was inferior, for agricultural purposes, to the latter, is satisfactorily refuted. The analysis of the respective kinds of lime, showed a decided advantage in the employment of *equal weights* of lime obtained from calcined shells, over that obtained from limestone.

The annexed extract furnishes a general summary of the comparison; it is preceded by a particular account of the analysis of ten specimens of limestone, from Baltimore, Harford, and Frederick counties.

"It will be perceived that three out of the ten are magnesian limestones; all of them contain more silica or sand than has been found in oyster shells, and one, said to be most extensively used in Harford county, contains as much as eleven per cent. of inert matter. It follows, therefore, that, as oyster shells are composed nearly of pure carbonate of lime, they will afford a lime containing scarcely an appreciable quantity of impurities. If well burnt, (which is the case when no effervescence is observed on treating them with a weak acid,) lime obtained from them may be deemed, with a fractional difference, equal, weight for weight, to the best stone lime; and as their chemical composition does not vary, there is nothing to be deducted from the value of the product in consequence of the impurities that exist, as exhibited by the foregoing table, in most limestones, and that must necessarily form a part of the residue when *these* are burnt.

If the comparative value of the two products be estimated by measure, a greater difference is discovered; but there is at the same time a disproportionate difference in price. A bushel of the best alum-lime weighs from ninety to a hundred pounds; whereas, the same bulk of shell lime, unground, weighs from sixty-five to seventy-five pounds, and perhaps when ground would weigh eighty pounds,—a difference of from twenty to twenty-five per cent. But the former costs from thirty to thirty-five cents at Baltimore, the most convenient spot for its delivery on tide-water, where the latter can be had for ten cents; whilst farmers, conveniently situated on the bay side, might themselves burn the shells at an expence not exceeding six cents a bushel. These remarks refer to the lime obtained from recent or fresh oyster shells; but there is little or no difference between it and that procured by the burning of those contained in the Indian shell banks, provided proper care be taken to separate them from the black mould and dirt with which they are mixed.

It has been supposed, that because alum-lime has been found to admit of a greater admixture of sand than shell lime, in the making of mortar, it was to be inferred that it is correspondingly better, or, as it is termed, *stronger* for agricultural purposes. But this is an unwarrantable conclusion; for, as this circumstance seems to depend upon the peculiar aggregation among the particles of the lime, which prevents it from *setting* too rapidly, (or, in other words, attracting water and carbonic acid from the atmosphere sooner than the wants of the mason require,) it would appear, on the contrary, that, if any inference is to be drawn from it, it is adverse to the conclusion; whilst, on the other hand, the fact that shell lime *sets very quickly* is favourable to the opinion, entertained by some persons, of its superior efficacy in agriculture,—it being generally understood that lime acts in the soil in the condition of carbonate of lime. Admitting, however, that the peculiar arrangement of the particles in stone lime which renders it in general coarser than the lime obtained from shells, may better fit it as a mechanical amendment

to certain soils, the difference is at most as one to three, according to the datum upon which its superiority is predicated; namely, that in the preparation of mortar, stone lime will bear three times as much sand as shell lime. But even in this respect the conclusion is not warranted, except perhaps in the case of a purely sandy soil, in which lime *alone* would, it is believed, prove of little service."

The discovery of green sand, forms an important epoch in the agricultural history of the state, on account of its value as a manure; and a considerable space is devoted to its consideration. The author combats the opinion expressed in the Farmer's Register, that the fertilizing properties of this marl, are due to the sulphate of lime which it contains, and attributes them, with much reason, to the potassa found by analysis to exist in it, adapting thus, the conclusion of Prof. H. D. Rogers, in regard to the Jersey green sand. The geologists account of this interesting formation,, as well as that of the *micacrous black sand* associated with it, will well reward a careful perusal.

The greater portion of the report is occupied with an examination of the three lower counties of the eastern shore of Maryland, but there is a chapter containing a "Geological examination of St. Mary's county, in reference to its agricultural resources"—and a number of localities of shell marl or fossiliferous deposites are pointed out which may be made available. The gypseous clay mentioned in the first report, is also alluded to as doubtlessly affording a valuable agricultural resource. In addition to the marl, St. Mary's county also possesses the Indian shell banks, already referred to as existing in the Eastern Shore counties.

Under the title "Progress of the Geological survey of the State" the geologist, gives a detailed account of the extent of country visited by him during his tour of duty. Twelve of the nineteen counties of the state have been visited, and six of them, it is said, thoroughly examined so far as the purposes of the survey appear to require.

It is believed that this brief sketch of the contents of the report, will suffice to justify the assertion made at the commencement of this notice, that the industry, skill, and scientific attainments of the gentlemen employed by the state of Maryland, are such as eminently qualify them to execute the task which they have undertaken. And should the citizens of that state duly appreciate and employ the resources at their command, prosperity and wealth will abound in situations where the soil has been hitherto deemed as of but little value; the same rich treasures being within their reach which were so long unknown in the state of New Jersey, and which, since their value has been known, has caused the wilderness to blossom as the rose.

It appears from information which may be relied on, that the able manner in which Prof. Ducatel has discharged his duty, and the judicious construction which he has placed upon the intentions of the legislature, have already much more than repaid the expenses which have or will attend the examination. Lands have risen in value, new products are beginning to be obtained from the soil, and instead of exhausting its fertility by continued cultivation, without the attempt at renewing it, the means pointed out have been resorted to, by which it may regain its original vigour, and even the "old fields" again become laden with harvests. From present indications, it appears almost certain that the splendid schemes of Internal Improvements, now projected by the state of Maryland, will be carried into operation at a very early day, thus affording the means of communication throughout the larger portion of her territorry. The fruits of the husbandman's labour, and

the mineral treasures from the mine, with which she appears to be liberally supplied, will thus find a ready market. And we may fairly hope that when the blessings which must result from such improvements are fully experienced, it will not be forgotten that a large debt of gratitude will be due to those branches of science, without whose aid the hidden treasure would never have been brought into view; and that a flourishing community will, in its turn, contribute liberally to their further advancement.

A Friend to Internal Improvement.

Note by the Editor.—We had read with much pleasure the Report which forms the subject of the foregoing notice, and had marked for abstract and insertion in the Journal, most of the passages quoted by our correspondent, which we should have accompanied with such remarks as might have appeared to us pertinent; we, however, have preferred to avail ourselves of the labours of others, which, we believe, will also be equally acceptable to our readers.

Note on the occurrence of Bituminous Coal near the city of Havana, in Cuba; by R. C. Taylor, *Mining Engineer.*

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen:—I observe with much interest the notice of your correspondent, in the last number of the Journal of the Franklin Institute (p. 375) of a plan for extensively working the beds of bituminous coal in Illinois. There is little doubt but that an abundant supply of coal, of the quality he describes, will be of great public utility in the South,—will supersede, for many purposes, the employment of other fuel;—and will have a widely extended market, even down to New Orleans, to the great private advantage also, I trust, of those who are preparing to put this undertaking in execution.

I do not think, however, that the Illinois coal will form a large article of export, to the Havana for instance, as your correspondent suggests. *The existence of extensive veins of coal within the tropics is now established.* Probably it is not yet generally known, that there have been recent discoveries of coal, of very extraordinary quality, at at least two points on the coast of Cuba, near the Havana. One of these is only three leagues from that city, and two miles from the sea at a place of embarkation. This mine has very recently been investigated by Mr. Clemson and myself, and forms the subject of a joint report to the proprietors, on the quality, quantity, and mode of working it efficiently.

I do not enter into a description of this singular coal, because we are preparing a separate communication for a scientific institution.

It is extremely probable that this coal, which contains so remarkable a proportion of bitumen, will be exported from the Havana to most of the ports on the southern extremity of this continent.

I may add that coal occurs near the north-east end of Jamaica. Mr. De la Beche informs me, however, that these coal seams are very thin, and that none of sufficient magnitude to render them worth working have been discovered.

I am, gentlemen, respectfully,

Philadelphia, July 13, 1836. Richard C. Taylor.

Franklin Institute.

Committee on Science and the Arts.

Report on Messrs. Garrett and Eastwich's Locomotive Steam Engines.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Locomotive Engines made by Messrs. Garrett and Eastwick, REPORT:—

That they have examined one of these engines now in progress of construction, at the shop of Messrs. Garrett and Eastwick, and witnessed the performance of another which has been completed and placed on the Philadelphia and Trenton Rail Road for trial.

They are constructed upon the principle of outside connections, the general arrangement being similar to that adopted by Mr. M. W. Baldwin, with some modifications, however, of sufficient importance to give them a distinct and original character. The most striking peculiarity is in the manner of reversing. This operation is performed in the different engines heretofore in use, by various contrivances, all of which involve the necessity of ungearing the connection of the eccentric rods with the rock shafts: consequently their action depends upon the contingency of throwing these parts again into gear, which can be effected only at particular points in the revolution of the eccentrics.

In the engines under consideration, the reversing is performed by means of movable valve seats, which are placed between the slides and the true seats, and connected with hand levers by rods passing through stuffing boxes in the steam chest.

In each movable seat are five passages, four of which are steam ways and one for the exhaust; two of the steam ways and the exhaust opening pass directly through the seat, the other two steam ways pass only about one-third through, and communicate with chambers which form oblique passages from one end of the seat to the other, so that the steam which enters the upper opening at one end of the seat, escapes by the lower opening at the opposite end.

When the movable seat is so adjusted that the direct passages coincide with the openings in the true seat, the action of the valve is similar to the common short slide: but if the seat be shifted, so that the communication shall be through the oblique passages, the course of the steam to the cylinder will be reversed without any change in the motion of the slide. This arrangement possesses the merit of simplicity in a high degree, and as its action does not depend upon any contingency, the engine can be reversed with certainty and precision. A small loss of steam results from the increased thickness of the valve seat, but it is believed the amount will not be sufficient to produce any appreciable effect upon the power of the engine. It has been suggested that the inequality of wear to which the movable seat will be subjected in its different positions, must render its surface irregular, and impair the tightness of the valve; some inconvenience may arise from this source, the extent of which can be determined only by experience; it is not apprehended, however, that the evil will be of a serious nature.

The situation of the cylinders and driving wheels in engines, with outside connections, allows a leverage to the working strain which very much increases the wear between the driving axles and their boxes, and also

twists the frame out of its proper form. Messrs. Garrett and Eastwick have endeavored to guard against the injury resulting from this cause by some slight changes in the parts most exposed to its effects.

Instead of turning down the bearings of the driving axle to obtain a shoulder for preventing lateral motion in the axle, they leave the axle its full size throughout, and provide against lateral motion by facing the hubs of the wheels, so as to form shoulders which bear against the outer ends of the boxes. The increased extent of bearing surface which is thus obtained both within the boxes and at their ends, enables them to resist more effectually, the thrust of the engine and adds to their durability.

The firmness of the whole machine has been increased by bracing the cylinders to the fire box, and bolting to the under side of the frame a strong plate of iron, which passes entirely around it and is secured to the pull bar.

The Committee have been informed that the engine which is upon the Trenton Road, has given entire satisfaction during a trial of several weeks constant service; the exhibition of its performance witnessed by them was highly gratifying, and they feel themselves warranted in saying that these engines afford evidence of ability to manufacture locomotives equal to any in the country for excellence of workmanship and general finish.

By order of the committee.

July 14, 1836. William Hamilton, *Actuary.*

Report on Mr. Prutzman's Lever Lock and Key.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, the Lever Lock and Key, invented by Mr. Prutzman of Philadelphia, REPORT:—

That they have examined the lock and key and find it to be a specimen of both *ingenuity and workmanship.*

The main feature in the lock is the manner of securing the bolt, so as to prevent its being operated on by means of a *pick*, and to prevent a key being fitted to it unless in detached parts. The lock is arranged with tumblers working vertically, and horizontally, so as to secure the bolt in its position, when locked or unlocked. The tumblers are operated on by means of a lever inserted in the bit of the key, and working on a centre. This lever is put in motion by a plate so arranged in the lock, as to pass into one of the wards of the key, and press the lever towards the barrel or stem. One end of this lever acts on a projection raised on one of the tumblers, causing it to descend, whilst a portion of the key acts on a parallel tumbler, causing it to ascend, the opposite end of the lever acts on a horizontal tumbler, and thereby relieves the bolt. When the bolt is shut the tumblers resume their former position and secure it in its place. A lever is placed between the two parallel tumblers and working on a centre, the bolt is secured at one end and moved by means of a key at the other causing the bolt to move in an opposite direction to that of the key.

The general arrangement of the lock is simple and good, and we may add the best that is within the knowledge of the Committee. From the common key an impression may be taken so as to form a duplicate, but from the present arrangement of a key, with a lever inserted, it will not be practicable, owing to the great accuracy required in the formation of the lever.

Mr. Prutzman deserves a great deal of credit for his *ingenuity.* The

Committee understand that several of the locks are at present in use; one in the banking house of the U. S. Bank, and others in the city of Baltimore. The Committee recommend it to the public, particularly to Bank directors.

By order of the committee.

May 12, 1836. WILLIAM HAMILTON, *Actuary.*

Report on Mr. Raub's Steam Gauge.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, Mr. Raub's Steam Gauge, REPORT:—

That Mr. Raub's Steam Gauge consists of a safety valve or piston, differing in no essential feature from ordinary safety valves, except that there is connected with it, by means of a lever, a weight, suspended in the water of the boiler, in such manner that when the water gets below a certain point, at which the weight is placed, the increased power of the weight, arising from its losing the support of the water, assists in opening the safety valve.

The practical effect is this:—If the safety valve is so graduated that steam will be blown off at a certain pressure, say seventy-five pounds to the inch, when the boiler is properly filled with water, it will escape at a lower pressure, say fifty or sixty pounds to the inch, according to the dimensions of the weight, when the water is too low. In this way it is proposed to avoid the explosions, or other evil effects which might arise from a portion of the boiler becoming bare of water and heated to a high degree.

The principle on which the weight acts, is like that of the floats which have been heretofore used, to show the height of water in the boiler, except that the weight in Mr. Raub's machine is connected with the ordinary safety valve, and the steam is blown off in large quantities when the water is too low, instead of a simple alarm being sounded.

The question for the consideration of the Committee is whether this combination, is advantageous. It is a matter of doubt, whether the blowing off of a quantity of steam when the water is deficient in the boiler, is not pernicious, as tending still more to exhaust the water; and whether the old application of the float to regulate the supply of water is not better. Waving these questions, however, it appears evident to the Committee that if a weight or float is to be used to cause the escape of steam, when the water is too low, it is better to have it attached to a separate valve, instead of being connected with the ordinary safety valve; because on the latter plan it will not operate when the steam is at a low density or pressure, although the water be deficient; and because when it does operate, the engineer cannot know whether its action is in consequence of the water being too low, or the steam too high. Hence the advantages usually anticipated from the use of floats, cannot be realized from this machine.

Whether floats or weights can safely be relied on for showing the low state of the water in the boiler, and for obviating its effects, is a question of experience which it is unnecessary here to discuss, inasmuch as Mr. Raub does not claim to have originated them, but to have made an improvement in their application: and for the reasons above stated, the Committee are not satisfied that his steam gauge, in its present form, will be found practically advantageous.

By order of the committee.

May 12, 1836. WILLIAM HAMILTON, *Actuary.*

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1836.

With Remarks and Exemplifications by the Editor.

1. For a *Machine for peeling Apples and Peaches;* J. W. Hatcher, Bedford county, Virginia, February 3.

This, we believe, is the sixth peeling machine that has been patented, and we do not think it any improvement upon the first, which was that of Moses Coates, obtained in 1803. The one before us, has a spindle, with a fork to receive the apple, a second spindle with an endless screw, a cog wheel, pinion, whirl and band, and other appendages for moving the knife; the apparatus for moving the knife is the only part claimed.

2. For a *Cooking Stove;* J. R. Cochran, Francestown, Hillsborough county, New Hampshire, February 3.

There is nothing in this stove worthy of special notice, its virtues depending upon the particular arrangement of the passages for heated air, and the dampers or valves. The claims are to "the form and construction of the apertures for the passage of the fire, and the dampers for closing either of them, or the passage under the oven, and the division of the passages for fire, by partitions, whereby the whole volume of fire is thrown on one side of the stove, and a greater heat thus produced on that side, and various degrees are produced in different parts of the stove at the same time, suitable for the different processes of cooking, and with less fuel than in any other stove of equal dimensions." As one object professed to be attained in a new cooking stove is, in nearly every case, to save fuel, we shall, by the time we have another five hundred stoves patented, not only save the whole, but have some to spare, should each of them save a little upwards of one five hundredth part only.

3. For an improvement in the art of *Manufacturing Rope and Cordage;* William Fanning, city of New York, February 3. (See specification.)

4. For a *Cooking Stove;* Daniel Williams, Scaghticoke, Rensselear county, New York, February 3.

This stove resembles, in form, a number of other cast-iron cooking stoves, having a body nearly rectangular, a fire place furnished with folding doors, an oven similarly furnished above it, and openings towards the back of the top plate, for cooking utensils. Its claim to novelty consists in making the fire place a sliding drawer, which can be brought forward upon the bottom plate; this drawer has a grate upon which the fuel is sustained, and a top plate, perforated for cooking utensils. When pushed in, there is, necessarily, a double plate between the fire and the interior of the oven.

The claims are to the movable, sliding fire place, the manner of connecting it with the other parts of the stove, and particularly to the obtain-

ing by its means, a double bottom to the oven, and thereby regulating the intensity of the heat; the provisions for carrying off the steam, &c.

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5. For an improvement in the *Cultivator;* James W. Garnet, Loretto, Essex county, Virginia, February 3.

This is called an improvement on the X, or Echelon Cultivator. "It consists of a curved cast-iron, marked No. 3, having in the under side two dovetail grooves, which the wrought iron marked No. 4, [shown in the drawing] is made to fit, so that when one point is worn out the other may be turned. Four of these are fixed in a bar of wood diagonally, at an angle of 45°, to a straight beam of the length and size of a common plough beam for a single horse."

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6. For a *Machine for Shelling Corn;* Isaac A. Hedges, Elmira, Tioga county, New York, February 3.

This machine, in its general principles, resembles the first shelling machine which was patented. It has a revolving cylinder and a concave, between which the ears of corn are to be shelled. The cylinder is to be formed of cast-iron staves, having teeth upon it, and the concave is also of cast-iron staves, with spaces between them for the escape of the grains of corn; the concave is borne up by springs. The ears are to be put into a hopper above the cylinder, and to be conducted through a proper aperture to the shelling part. The claim is to "the concave cylindrical surface by a combination of staves, with springs attached as herein described; and the application of such surface so formed to the purposes of corn shelling; as also the application of such surface to a cylinder for the same purpose."

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7. For an *Oven to be used over the common Fire Place;* Samuel Pollard, Orono, Penobscot county, Maine, February 3.

This patent is taken for an improvement upon the oven patented by the same person in June, 1835, and noticed at page 46, vol. XVII. The sheet-iron oven is placed, as before, across the chimney, above its throat, and in addition to the flue leading to it, about level with the surface of the fire, there is a second flue near the throat of the chimney, which is closed by a door. A grate is fixed in the flue to sustain fuel, that a fire may be lighted there when there is none in the fire place. The claim is to "the introduction of the second described flue, damper, and grate; the outside cylinder and the damper above, or on the top of it, these being the additions now made, as improvements." The second cylinder forms the flue around the oven, and is like that in common use in similar ovens set in jambs.

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8. For an improvement in *Saw Mills;* George W. Black, Montgomery county, Tennessee, February 3.

The object in constructing this mill is to apply the power above the surface of the ground. The main cog wheel, driven by any suitable power, gears into a pinion on a pitman shaft above the sills, the pitman extending thence to a rocking shaft which gives motion to the saw frame, hung in the usual way. The claim is to the horizontal pitman and its appurtenances, including "the entire mode of driving the saw, or saws, and the mode of applying the power to them," in which the patentee perceives numerous

advantages, which we apprehend will not be realized in many situations, and no where, assuredly, where water power is employed.

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9. For a *Straw Cutter;* Isaac S. Wright, Elbridge, Onondaga county, New York, February 3. (See specification.)

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10. For a *Machine for Harvesting, Thrashing, and Cleaning Grain;* Eliakim Briggs and George W. Carpenter, Covington, Franklin county, New York, February 5.

This machine is to run on four wheels, like wagon wheels, the adhesion of the hind wheels to the ground carrying revolving scythes, a cylinder thrashing machine, and other appurtenances. The apparatus is not fully described, and we are very apprehensive that it had not been fairly tried before being patented, as we are of opinion that its promise upon paper would not be realized in the wheat field. Its power to cut, convey, thrash, and clean grain, and the satisfactory concurrent action of all its parts, would not, we think, have given it a passport to the Patent Office.

The claim is to "the manner and principles of applying the power of a team to cutting, thrashing, and cleaning grain, by moving forward the machine; of cutting grain, of carrying it to the thrasher, of thrashing, and of cleaning grain, by power so applied." This claim does not, with sufficient distinctness, state the particular machinery for effecting the object, refers to no individual part of it, but appears to relate more to the end than to the means, whilst the latter is the only thing patentable.

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11. For an improved *Saddle Tree;* Andrew R. McBride, Williamson county, Tennessee, February 5.

This saddle tree is to be made of four pieces of wood only. The crotch or front piece is to be formed from the natural growth of the timber. The cantle is also to be a single piece, and these are to be connected by the two side pieces. Whether the crotch is to be made from a crotch, or how the natural growth is to be obtained, we do not learn, nor are the directions given, in general, specific in their character; the claim is entirely omitted, and we are left, therefore, to infer, for ourselves, what it is intended to patent.

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12. For a *Horse Rake for Hay and Grain;* Joseph W. Webb, Mount Morris, Livingston county, New York, February 5.

Behind an axletree with two wheels, there is a frame which sustains the rake-frame, and the latter slides up and down between cheeks, furnished with grooves for that purpose; upon the bottom edge of the rake-frame are teeth, curved forward and reaching to the ground; a man stationed on a platform above the axle tree, raises the rake-frame by means of a lever, when it has collected the desired quantity, and thus deposites it. The points of the rake teeth curve back suddenly to prevent their catching in the ground, The claim is to "the manner of raising or depressing the rake at pleasure, by means of the perpendicular grooves and the lever; and the manner of curving the teeth backwards, for the purpose set forth."

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13. For a *Machine for cleaning smut from Buckwheat and Rice;* Samuel Richardson, Elmira, Tioga county, New York, February 5.

It is very well that the patentee sets forth no exclusive claim to this ma-

chine, as, were he to do so, he would encounter a host of competitors. The whole consists of a hollow cast-iron cone, in which runs a conical nut, both properly grooved, in the well known old coffee mill fashion.

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14. For a *Press for Cotton, Tobacco, &c.;* Azel M. McLean, Russelville, Logan county, Kentucky, February 5.

This press consists of a lever working on a fulcrum between two upright posts, the articles to be pressed being placed under the lever, and resting on sills, or a platform on the ground. A rack and pinion below the long end of the lever serves to raise or lower it; and the improvement claimed consists in extending the lever beyond the uprights, so that it shall have a short arm projecting out far enough to press the articles by the elevation of the long arm, as they are pressed on the opposite side by its depression.

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15. For a *Horse Power;* Dudley Marvin, Canandaigua, Ontario county, New York, February 5.

This machine is, in its general construction, like many which have preceded it, consisting of an endless chain floor upon which the animal walks, which floor is sustained by friction rollers running upon ways, and connected so as to form endless chains; it is the peculiar manner in which these are put together, upon which the patentee must depend to sustain a claim, and he says, "I confine my claim to the particular manner in which I construct the power chain, and the friction chain, as described, together with their combination with those accessary parts which are necessary to their action. I do not claim either of the individual parts as separate and uncombined."

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16. For a *Churn;* Hezekiah Roberts, Seneca Falls, Seneca county, New York, February 5.

A vertical churn is to have the dasher made to revolve alternately in reversed directions, by means of a double strap, the two ends of which are wound round the shaft, and are alternately acted upon. To produce this motion, the patentee employs a wheel and pinion, on the shaft of the latter of which there is a crank and fly wheel. A pitman from the crank is made to vibrate a wheel which communicates the alternating revolution by means of the straps. The claim is to "the crank, connecting rod, spur wheel, pinion, and balance wheel." All of which are well known affairs.

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17. For an improvement in the *Process of preparing bark and obtaining the extract therefrom;* Daniel Williams, Boston, Massachusetts, February 5.

We are informed that the bark is to be first divested of its outer part, after which the inner bark is to be cut into small pieces, and the tanning principle extracted therefrom by boiling, or by steam; the water is then evaporated and the extract fit for use. The thing claimed is the extracting tannin from the inner bark cut into pieces, instead of grinding or pulverizing it, by which means, it is said, the extract is more pure, being free from the admixture of the minute particles which remain in it when procured from the ground material.

How many thousand times the chemist has thus obtained the extract of bark in his laboratory, we cannot tell, but certainly more frequently than from the pulverized material.

18. For an improvement in the *Cotton Saw Gin;* William and James M'Creight, Winnsborough, Fairfield district, South Carolina, February 5.

The gin retains its usual form, but the patentees claim, "First, a movable breast; second, sliding ribs, and third, the centres of the brush, and the pivots on which they turn," which improvements, they say, render the apparatus more durable, and more easily kept in order.

"The breast is hung to the front of the gin with two hinges, and can always be raised so as to get at the saws," when they require any attention. The sliding ribs are so called, because they are made so as to shift, or slide, and expose new portions of them to the action of the seed, so that they may be shifted endwise four or five times, before they require to be renewed; they are confined at their ends by screwed cleats, which are loosened when the ribs are to be shifted. The pivots of the brush are made of square cast-steel, pointed at each end, and fixed in a manner which allows of their being shifted readily when one end is worn.

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19. For an improvement upon a *Grist Mill;* William and James M'Creight, Winnsborough, Fairfield district, South Carolina, February 5.

This is said to be an improvement upon the grist mill, patented by Ed. Newman, in February, 1827.

The improvement consists in the lengthening of the spindle to twice the original amount, and in the mode of fixing and regulating the hard wood bushes which bear against it. We do not think it necessary to particularize the mode of fixing the hard wood for this purpose, but will merely say that the bush consists of four pieces, standing endwise against the spindle, confined in their places, and regulated in their bearing, by means of screws.

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20. For an improvement in *Locomotive Steam Engines;* Henry R. Campbell, Northern Liberties, Philadelphia county, Pennsylvania, February 5.

"My improvement consists in the combination and application to each locomotive steam engine, of two pair of driving or propelling wheels, and two pair of guide wheels. I also claim as a modification, and as a part of my improvement, the combination and application to each locomotive steam engine, of two pairs of driving or propelling wheels, and one pair of guide wheels. What I denominate *guide wheels*, are those which carry a portion of the weight of the engine and conduct it along the rail road, without direct connexion with the driving wheels."

The objects in view are to increase the weight and power of the engine; to extend its bearing and weight over a larger portion of the road; to increase the adhesion by doubling the number of driving wheels; "to increase the facility of turning curves by compounding the leverage of the engine upon the flanches of the wheels against the edges of the rails;" to reduce the wear and tear, and consequently the expense of transportation on rail-roads.

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21. For a *Bee Hive;* James W. Hubbard, Canterbury, Merrimac county, New Hampshire, February 5.

There is not any thing in the contrivance of this hive which appears to

merit particular notice, the thing claimed is a mere trifling matter of arrangement.

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22. For *Flasks for moulding hollow bulge Ware;* Lewis H. Maus, Danville, Columbia county, Pennsylvania, February 5.

At page 60 of the last volume, we published the specification of a patent obtained by David Stewart of Danville, under a title, and for a purpose, similar to the foregoing. We have not had time to compare the two plans with all that care which is necessary to enable us to point out their resemblances and differences, but our present impression is, that they are substantially the same. In the former case there is a distinct claim made, pointing out the particulars of the improvement, as may be seen by turning to the specification; in that before us, certain peculiarities in the plan pursued are spoken of, but there is not any formal claim, although one may probably be made out by construction. We shall probably publish Mr. Maus' specification hereafter.

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23. For a *Thrashing Machine;* Lewis H. Maus, Danville, Columbia county, Pennsylvania, February 5.

This is said to be an improvement on James Parson's thrashing machine. The cylinder and concave are to be of cast-iron, and the improvement appears to consist in the casting it in parts more light and convenient than the original machine; there, however, is no specific claim, nor is there any thing in the operation of the machine, as now patented, to distinguish it from other cylinder and concave thrashing machines.

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24. For an improvement in the *Saw Mill Saw;* Benjamin K. Barber, Johnsburgh, Warren county, New York, February 5.

Two teeth in the middle of the saw are to be set in a winding position, and are to be ground "to an edge on the outside, so that the upper outer edge of the teeth shall be sharp, and stand out on each side of the saw more than even with the outside edge of the points of the other teeth, when set about half as wide as is usual for common sawing." There is also to be a kind of tooth attached to the back of the saw, and set in a winding position, so as to cut up on one side and down on the other. We confess that we do not fully comprehend the description, nor do we see how teeth in the centre of a saw are to operate on stuff to be sawed which is wider than the double length of the crank; a kind of stuff not unfrequently cut. There is no claim, and we do not know that one is required, as the whole thing may be new.

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25. For a mode of *Equalizing the blood of the human system;* Solomon R. Terrell, Burton, Yazoo county, Mississippi, February 5.

The arm, leg, or whole body, is to be enclosed in a tube, or vessel, rendered air tight by India rubber, or other suitable substance, and the air is then to be extracted by means of an air pump, so as to take off atmospheric pressure from the part enclosed, and thereby cause an influx of blood; to promote which additional warmth is to be applied. This is the sum and substance of the patent. About thirty years ago a patent was obtained in England for a similar apparatus, and an agent came into this country to carry the plan into effect here. It was intended not only to exhaust the air as above proposed, but to admit steam or gases, to act upon the limb or

other part, enclosed. We repeatedly saw the instruments in Philadelphia, but after the lapse of three or four months heard no more of them.

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26. For an improvement in *Mortise and other Locks;* Philos and Eli W. Blake, New Haven, Connecticut, February 5.

This lock exhibits much ingenuity and skill in its construction, but the description and drawing would both be necessary to make the plan adequately known. There are eight specific claims, which if given alone, would not afford an idea of the structure; we must therefore pass it over, as requiring more space for illustration than can be afforded.

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27. For *Preventing the heating of Flour and Meal in Grinding;* Isaiah Pape, Windham, Cumberland county, Maine, February 5.

A strap of leather is to be buckled, or otherwise fastened, round, and near the lower edge of the upper stone or runner; and to this are attached fifteen, or any other preferred number of blocks, or pieces of iron, which hang loosely upon the edge of the bed stone; these are to prevent the flour accumulating between the stones and curb, and remove it, consequently, from the source of heat.

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28. For *Preventing malt liquors from becoming sour;* Josiah Stowell, Manchester, Hillsborough county, New Hampshire. (See specification.)

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29. For a *Crimping Form, for crimping boots;* William Gerrish, Poland, Cumberland county, Maine, February 10.

The form, with the screws and nuts by which the leather is to be drawn on to it, are fully described, but there is no claim made, or any attempt to discriminate between this and the numerous other contrivances for the same purpose.

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30. For an improvement in *Gun Locks;* Samuel Morrison, Milton, Northumberland county, Pennsylvania, February 10.

One object in this lock is to enable the gunner to fire off either one or two loads at the same time, or at separate times, from a single barrel. The first load is received in a chamber somewhat smaller than the general bore of the gun, and the charge is covered by its ball, after which the second load is rammed down; there must be two cups for percussion powder, or nipples for two caps, with a contrivance to prevent the discharge of the first charge, when one only is to be fired off. There are six separate claims to distinct parts of the lock and its appendages, which we do not think it necessary to give. It has been repeatedly proposed to place several charges in a single barrel, to be fired in succession, and the mode of effecting it has been described, but there, we believe, the matter has ended, and is likely again to end.

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31. For a *Twain Water Wheel;* William L. Elgar, Chester county, New Hampshire, February 10.

Here are to be two shafts each having buckets, or floats, at one end, and geared together at the other by cog wheels. The water is to be "applied at the centre, so as to exert its power on both," and the claim made is to

"the applying the two wheels together, thereby obtaining a much greater power from the same quantity of water."

We are not instructed in the manner of causing the water to act upon the floats in the centre only, and we really cannot tell how it is to be effected; the thing, however, is altogether unworthy of thought.

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32. For a machine for *Planing and Dressing Boards;* Melzer Twells, Milo, Yates county, New York, February 10.

A fare wheel is to revolve vertically, carrying four, or any other number of, plane irons, and close to the periphery are to be cutting bits, or hooks, to precede the double or single irons in their operation. The boards are to be held edgewise, resting against standards upon a suitable carriage, and held against the vertical standards by dogs. The plane wheel is to be driven by one band and whirl, and the carriage to be moved by another. This comprises all the information given, and there is not any claim. The plan has nothing in it having the remotest alliance to novelty, nor does it bear those features of maturity which would lead to the conclusion that it had been tried. The fact, is that as presented in the specification, it will not work well, and if it would, a patent could not be sustained for it.

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33. For a *Machine for Shelling Corn;* Henry G. Neale, Poultney, Rutland county, Vermont, February 10.

A rubbing board, furnished with teeth, or cased with a toothed cast-iron plate, is made to slide horizontally in grooves, by means of a handle, a second rubbing board being placed under it, and borne up towards it by steel or wooden springs attached to the frame. The claim is to the whole machine as constructed.

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34. For a *Machine for cutting Straw, Hay, &c. &c.;* Chauncy D. Skinner and Dana Reed, Haddam, Middlesex county, Connecticut, February 10.

The specification of this patent gives a verbose description of the dimensions of the different parts of the machine, and ends by claiming "the combination of the various parts as described." The material to be cut is placed in a trough in the usual way, and the knife is fixed upon the face of a wheel revolving vertically; the shaft of this wheel has a crank on it, and is to be driven by the aid of a treadle, in the manner of a foot lathe. There is no feeding apparatus, or any thing of moment not pointed out by us.

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35. For a *Churn;* Lyman Whittier, Vienna, Kennebec county, Maine, February 10.

A churn, in the ordinary form of the vertical kind, is so hung as to swing backwards and forwards like a pendulum, there being a suitable frame to sustain it. A vertical shaft passes through the top, and runs in a pivot at the bottom of the churn; wings, or dashers, being attached to it to agitate the cream. A small cog wheel, or pinion, surrounds the vertical shaft, above the lid of the churn, and the teeth of this wheel take into teeth on a piece of timber, forming a rack, and attached to the frame, which, when the churn is swung, causes the shaft to revolve; the swinging may be effected by means of a rod, or other contrivance, attached to it for that purpose. The claim is to the mode of producing motion by the action of the cogs.

36. For a *Machine for Cutting Straw;* Joseph Evered, an alien, who has resided two years in the United States, February 10.

The description of this machine refers to the drawing throughout, and ends with a claim to "the finger wheels; the rising and falling of the rollers; the compression produced by the lever and weight; the concavity of the knives edges; the plan of the face of the wheel through which the straw is drawn; the centre screw on the worm and spindle, and its rise." The general form of the machine is such as has been in use for more than half a century, the straw being contained in a trough, furnished with fluted feeding rollers, and the cutting effected by curved knives on the arms of a fly wheel, revolving at one end of the box; these curved knives, it will be seen, are claimed as new; if the inventor could go back as far as we can in the recollection of the use of curved knives, in a manner precisely the same with their employment in this machine, he would not place *himself* among the novelties of the day. There are other things claimed, which are in the same predicament, and where so many individual things are particularized, it is not easy to avoid such an error, as few persons are fully informed of what has previously been done in those cases where machines have been long employed, as in cutting straw.

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37. For a *Thrashing Machine;* Thomas Beede, Sandwich, Stafford county, New Hampshire, February 10.

This is a cylinder and concave machine, with some peculiarities about it upon which to found a claim, but not substantially different from numerous others of the same general construction.

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38. For a *Cooking Stove;* John J. Giraud, Baltimore, Maryland, February 5.

The main improvement spoken of in the specification of this stove, is a *box door*, which is to answer the purpose of the ordinary *Dutch oven*, but what are the peculiarities of its construction we cannot discover, as it is mentioned in the specification in the most general way. There is a drawing, with letters on the respective parts, but we find no references to them, and most of the things represented have no novelty whatever. The claim is to "the door oven at the front of the fire place, as well as the general combination and structure of the entire instrument." The *door oven*, which is specially claimed, is to be dispensed with when the stove is used for warming only.

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39. For an improved *Molasses Gate;* Charles W. Perkham, New Haven, Connecticut, February 10.

This gate is constructed like those in general use, but a spring is used to press the gate, or sliding plate, against the orifice of the instrument, and the employment of the spring, exclusively, is the subject of the claim.

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40. For an improvement in the *Flyer for twisting roping, and yarn of cotton, hemp, or flax;* Willard T. Eddy, Ithaca, Tompkins county, New York, February 10.

The claim made is to "the combination, arrangement, and adaptation of the several parts of the spindle and flyer for twisting roping; but particularly the mode of hanging the spindles on a joint, and securing it by a spring; also the spring bearing against the end of the spool." The par-

ticulars referred to cannot well be described without the aid of the drawing.

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41. For a *Slide Valve for Steam Engines;* Alexander M'Causland, Jr. City of Philadelphia, February 10.

This valve is constructed with a view to easy action, and facility of reversing the motion; the description refers throughout to the drawing; the claim is to "the opening through the valve, thus admitting the steam to act equally, and at once, upon the lid, or upper plate of the steam chest; and also the manner described of packing the top of the valve with metallic packing."

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42. For a *Crane for moving heavy bodies;* Elias Marsh, Oswego, Oswego county, New York, February 10.

In this crane the power is applied to a horizontal lever attached to a vertical shaft, in the manner of the common horse mill. At the upper end of this shaft there is a drum, round which the hoisting rope is to coil. The other end of the rope extends to the outer extremity of the arm of a common crane, and leads over pulleys in the ordinary way, to a block. Over the shaft of the crane there are two guide pulleys for the hoisting rope, keeping it in its place as the crane is turned in any direction. The drum at the upper end of the first named shaft, turns upon an iron gudgeon, and rests upon a coupling box, so that when the load has been raised, and the crane is turned to the point where it is to be dumped, by pulling on a lever the drum is disengaged from the coupling box, and the load descends. The claims are to "the arrangement by which the arm is left free to traverse whilst the force is operating, or by which the force applied is made to act and react in the direction of the arm, without the intervention of check ropes, windlasses, &c., attached to the boom, as in ordinary use." So far as this applies to the allowing the crane to turn freely whilst the hoisting rope is kept in its place by the guide pulleys, there is no novelty in the thing, and it seems to us as though this was mainly alluded to.

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43. For an improvement in *Piano Fortes;* John Pethick, City of New York, February 12.

The improvements claimed relate to the *action* of the instrument, and consist in "making the *breast*, and *lip*, or *notch* of the *hammer butt*, or *knuckle*, about double the thickness of those heretofore made; to wit, of the same breadth as the *hinge butt*, or a trifle less, to admit of its moving freely without chaffing each other;" to accomplish this, the shape of the hinge butt is altered, in a way described and shown in the drawings, and allowing "more than the usual width of the cloth, or other soft and suitable substance, for the centre pin to work on. In preserving the full breadth of the *Jack flyer*, or connecting lever, instead of passing it down to a breadth corresponding with that of the *hammer teeth*, as heretofore practised." These improvements are upon the French, or grand action, invented by Papp, of Paris.

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44. For *Constructing Boats to be used under water;* Edward P. Fitzpatrick, Mount Morris, Livingston county, New York, February 12.

These boats are to be constructed with a triangular cross section, one angle forming the lower point, or keel; the stem and stern are to be sloped

from the lower angle to the upper side, but they are to be, otherwise, perfectly straight. These boats are to be connected together, and to be entirely submersed; of course they must be air-tight. Pillars from them are to support a platform above the water, upon which the load is to be placed. Upon the lower side of this platform there are to be semi-cylindrical hollow trunks. "The intention of these semi-cylinders is to preserve the equilibrium of the platform, or receiving vessel, when in motion, and when the hollow triangular boats are sufficiently sunk." The propelling is to be effected by means of a paddle wheel, or of a spiral screw, placed between the boats. The claim is to "the form and construction, as being better suited to the purpose intended, of preventing the agitation of the surface in so great a degree as has been the case heretofore."

Those who have been in the habit of using Nicholson's Hydrometer, will not need to be told of the difficulty, we might say impossibility, of regulating the load of such a boat; but independently of this the whole plan is open to numerous valid objections, and proceeds upon the false assumption that the water may be agitated just below the surface, whilst it remains comparatively tranquil there.

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45. For a *Churn;* John E. Thomas, Winchester, Preble county, Ohio, February 12.

The body of the churn is to be a box, or case, through which two shafts are to run, furnished with slats, or dashers, passing between each other; on the outer end of each shaft there is to be a pinion, which is to be turned by a cog wheel; numerous examples of this churn exist in the patent office, and probably elsewhere.

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46. For a *Horse Power;* Joseph Austin, Franklin county, Vermont, February 12.

No claim is made by the patentee to the construction of this horse power and although such an omission is sometimes to be regretted, it, in the present instance, will not be productive of the slightest loss or inconvenience, a claim having been made thereto more than forty-one years ago, and a drawing and description of it having been given in the second volume of the Repertory of Arts, published in 1795. The plan is to obtain power by placing the animal near the top of a large, revolving drum.

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47. For a *Machine for Cleaning and Dressing Feathers;* Daniel K. Hall, City of New York, February 12.

Feather dressing machines are now the order of the day, and have become so numerous as to prevent our looking after any thing new, in a new patent, excepting merely a change of form, whilst the principle of action is identical. We find no cause, in the example before us, to alter these views.

The feathers are to be put into a cylindrical screen which may be formed of wire, with solid ends. A shaft furnished with pins to agitate the feathers passes through, and may be made to revolve in, this screen. When charged with feathers it is to run upon ways into a chamber, or oven, in which it is to be enclosed by a door, admitting the shaft to pass through it. The heated air from a stove, and the vapour of water from a vessel placed upon it, aided by the agitation of the feathers, effect the purpose intended. There is not any claim made.

48. For *Securing the Drop Doors of Rail Road Cars;* John K. Smith, Port Clinton, Schuylkill county, Pennsylvania, February 12.

This is not an affair which will interest many of our readers, nor one which could be intelligibly placed before them without the drawings; the claim being "to the various pieces which compose the fastening, and their general arrangement."

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49. For a *Steam Feather Dresser;* Samuel Keplinger, City of Baltimore, February 12.

The feathers are to be put into a cylinder, similar to that described at No. 87, provided with a shaft and agitators, also similar. A second cylinder is to surround the first, at a distance of two or three inches from it; and into this steam is to be admitted from a boiler. The claim is made to "the combination, arrangement, and adaptation of the several parts of the before described machine." A standing claim which fits equally on to every contrivance, be the same old or new; but to this is added "particularly the mode of heating the feathers *by steam*, in the manner described."

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50. For a *Washing Machine;* Luther Davison, Norwich, New London county, Connecticut, February 12.

A cylinder, the ends of which may be of wood, and the barrel part of zinc, is to revolve horizontally; round bars of wood are to reach from head to head, on its inside, standing at a small distance from its periphery, and allowing a space between each of them. A partition is also to extend across the middle of the cylinder, formed of similar bars, and dividing it into two equal parts. A door on the side of the cylinder allows the clothes to be put into either division of it.

"What I claim, is the arrangement of the bars in said cylinder, the partition of the cylinder, and the principle of washing the clothes in two separate parts of the same." A *principle*, the discovery of which will scarcely confer immortality.

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51. For *Apparatus for Drying Cotton after it has been picked, &c.;* John Philbrick, Wilkinson county, Mississippi, February 12. (See Specification.)

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52. For a *Blowpipe for Furnaces;* John Barker, City of Baltimore, February 12.

The patent for this blowpipe, is about to be re-issued under an amended specification, which we shall give at length.

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53. For a *Sliding Coal Grate;* John C. Howard, Howard's Valley, Windham county, Connecticut, February 13.

A cast-iron grate, upon which a fire may be made, is to run in and out upon ways, on the sides of a fire place. The description of the thing is very imperfect, but a claim is made to "the manner of constructing this grate and its appendages, so as to be passed in and out of the chimney back, fire frame, or stove." Sliding, or "rail way grates," are no novelties, there, however, may be some unperceived advantages in the plan intended to be described.

54. For a *Machine for Shelling Corn;* Ira Smith, Downingtown, Chester county, Pennsylvania, February 13.

This machine does its work by means of a vertical revolving plate, constructed in the well known way of making such plates. The supposed novelty will appear from the claim, which is to "putting teeth or projections on both sides of the wheel, instead of on one side, as in the common method, thereby shelling twice as fast." It so happens, however, that this contrivance is old, having been patented some years since, and subsequently re-invented more than once.

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55. For a *Machine for making Screws;* William Keone, Monroe, Orange county, New York.

This machine is for cutting the threads upon wood screws; it is contrived with considerable ingenuity, and possesses much originality; it appears likely to operate well, and should it do so, and make screws with sufficient speed, it will be of great value; from want of the latter property, several such machines, in other respects very perfect, have been abandoned. The dies in this machine consist of two cast-steel wheels, about an inch and a half in diameter, fixed so as to revolve on axes, with their edges nearly in contact; upon these edges the female screw is cut. They are so constructed as to be borne up towards each other, whilst the screw is being cut, and they, and the apparatus to which they are attached, are contained within a can, or vessel, filled with oil and water. A hollow vertical shaft passes through the bottom of the vessel, and through this shaft the requisite revolving motion is communicated. The contrivances to effect this, and the other requisite objects, are too complex for verbal description. The claim is "to the combination and arrangement of the several parts of the machine for making screws, particularly the mode of giving the dies a simultaneous horizontal and vertical movement in oil and water, whilst cutting the screw." We do not think the former part of this claim sufficiently guarded, as the combination and arrangement may be much varied, whilst the result will be the same, and the means substantially similar.

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56. For an improvement in the *Wheat Fan;* David Flanders and Calender Rathburn, Fort Covington, Franklin county, New York, February 13.

The general construction of this wheat fan is the same as those in common use, and although much pains have been taken to describe its individual parts, we are not told, and are unable to discover, in what its special utility and novelty consist.

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57. For a *Machine for Cutting Sausage Meat;* Ambrose Henkel, Shenandoah county, Virginia, February 13.

The general construction of this machine may be inferred from the claim to "a cylinder with knives; secondly, their cutting between bars of any kind; and thirdly, the general construction of the machine." This claim is much too broad, the two first items in it not being sustained by their novelty, and not, therefore, sustaining the third.

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58. For an improvement in *Hydraulic Docks;* Zebedee King, City of New York, February 13.

Those who are acquainted with the different plans which have been

devised for raising vessels out of the water for the purpose of repair, know that the principle of Bramah's press is applied to that purpose in the Hydraulic Dock, at New York, and probably elsewhere. The present patent is taken for improvements on the mode of constructing and using certain parts of that apparatus, which improvements are explained at large, and fully shown in the drawings, but cannot well be presented in a summary.

[TO BE CONTINUED.]

Specification of a patent for an improvement in the art of manufacturing Rope or Cordage. Granted to WILLIAM FANNING, *City of New York, February 3rd,* 1836.

To all to whom these presents shall come, be it known, that I, William Fanning, of the City of New York, in the county and State of New York, have invented a new and useful improvement on the art and manufacture of rope, or cordage, made from hemp, flax, cotton, manilla, cicol, or grass, and that the following is a full and exact description of the method of making the circumvolved rope.

What I claim as my own improvement, and not previously known, in the art and manufacture of rope, or cordage, is making the ready, or strand, of the rope, with as many true and separate spiral twists and turns, as there are circles of threads in the ready, or strand, when finished; which is done by first taking as many threads as are necessary to form the inner, or centre, circle of the ready, or strand, placing them through as many holes made circular on a plate; they are then fastened to a machine sufficient to give sufficient turn, and drawn through a tube of proper size, giving to threads and centre circle of ready, or stand, a spiral form in exact proportion to its size. The first circle formed is then put through the centre hole of the plate, and as many threads rove through the holes of the plate in a circular manner, as are necessary to form the second circle; the threads and centre circle first formed, is then fastened to a second machine, standing a proper distance from the first named, and drawn together through a second tube of proper size, the circle of threads last rove completely circumvoling the centre of first circle formed, giving to yarns and second circle a spiral form in exact proportion to size of circle formed, and every succeeding circle is rove through the plate, tubed, twisted, and formed in the same manner as the above described second circle, giving to each circle a spiral form in exact proportion to its size, and every circle of threads rove separately through the holes of the plate tubed and formed, giving a true spiral form to each, will be completely circumvolved by the succeeding circle and rendered impervious to water: the threads are reeled separately on bobbins, and placed in a frame, as usual, in making other ropes. The machine used in making the circumvolved, together with the rope, or band, applied to the same, is such as has been in common use for many years, to which I have no claim of invention or improvement.

WILLIAM FANNING.

Specification of a patent for an improved machine for Cutting Straw. Granted to ISAAC S. WRIGHT, *Elbridge, Onondaga county, New York, February 3rd,* 1836.

To all whom it may concern, be it known, that I, Isaac S. Wright, of

Elbridge, in the county of Onondaga, and the State of New York, have invented certain improvements in the construction of machines for cutting straw, and I do hereby declare that the following is a full and exact description thereof.

The straw to be cut is placed in a trough in the usual way, but the trough differs in form from those generally employed, being, most commonly, made out of two pieces of plank, joined together lengthwise, at right angles, or at any angle greater or less than a right angle, as may be preferred. This trough has a cutting knife at one end, which is fixed into a frame sliding up and down in grooves, like a mill saw frame. This knife consists of two cutting parts, united together at the middle, so as to form a right angle, or any angle greater or less than a right angle, as may be preferred. The angle of the trough points downwards, and the angle of the knife upwards, the cutting edge being downwards. The gate, or frame, which carries the knife, may be moved up and down by means of a lever, a treadle, a crank, or in any of the known ways of producing such a motion. The fore edge of the trough is armed with iron and steel for the knife to cut against. Both the knife and the trough, may, instead of being in the angular shape described, be made curvilinear, in which case it will be best to make the curve a segment of a small circle in the middle, corresponding with the angular point above mentioned. The object in view will, in either case, be equally well attained; this object being so to form the knife and the trough, that as the former comes down upon the straw they shall concur in gathering and forcing it into a compact state. The same end may be partially attained by giving the described shape to the knife alone. I intend sometimes to surmount that part of the trough which is against the knife, by a short angular or curved piece in the same form with the trough inverted, for the purpose of keeping the upper portion of the straw more completely together whilst feeding. The feeding may be performed in any of the usual ways.

What I claim as my invention, and which I intend to secure by letters patent, is the angular, or curved, form of the knife above described, whether used with or without a trough, similarly formed for the purpose set forth. I do not claim the angular trough when used alone, the same having been previously employed, but without an angular or curved knife, such as is herein described.

Isaac S. Wright.

Specification of a patent for a method of preventing ale, beer, and other malt liquors from becoming acid in warm weather. Granted to Josiah Stowell, *Manchester, Hillsborough county, New Hampshire, February 5th,* 1836.

To all to whom these presents shall come, be it known, that I, Josiah Stowell, of Manchester, in the county of Hillsborough, and State of New Hampshire, have discovered and applied to use a new and useful method, or process, for preventing ale, beer, and other malt liquors, from becoming acid, or sour, in warm, or hot, weather, and from preventing the wash, or mash, of distillers, from becoming acid: and that the following is a full and exact description thereof.

To preserve malt liquor where the temperature of the weather is from seventy-four to ninety-four degrees, Fahrenheit's thermometer, for every

one hundred and seventy gallons of liquor apply one pound of raisins in the following manner: Put the raisins into a linen, or cotton, bag, and then put the bag containing the raisins in the liquor before fermentation. The liquor may then be let down at sixty-five, or as high as seventy degrees Fahrenheit's thermometer.

The bag containing the raisins must remain in the vat until the process of fermentation has so far advanced as to produce a white appearance, or scum, all over the surface of the liquor, which will probably take place in about twenty-four hours. The bag containing the raisins must then be taken out, and the liquor left until fermentation ceases. The degree of heat in the place where the working vat is situated, should not exceed sixty-six, nor be less than sixty degrees of Fahrenheit's thermometer.

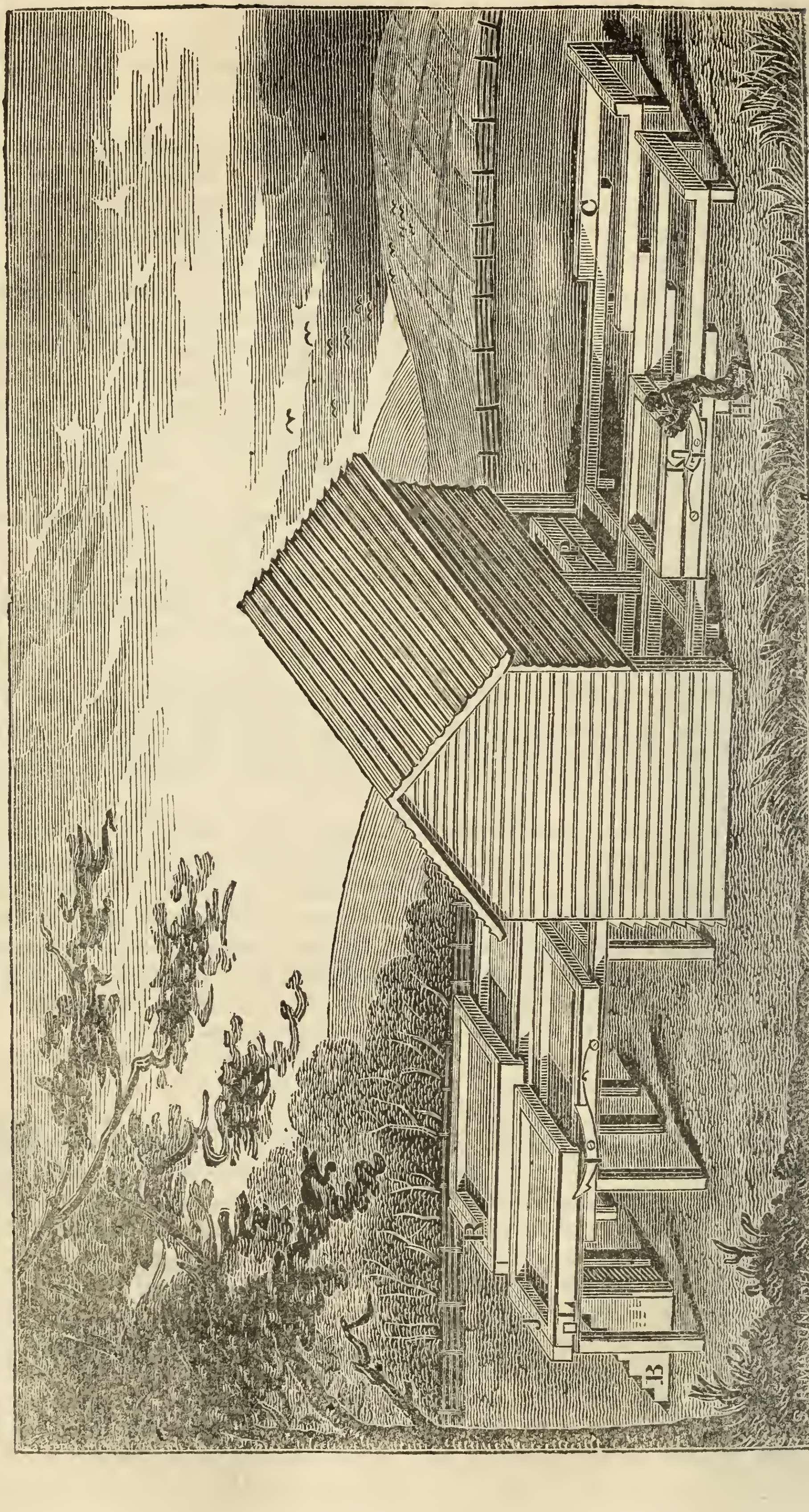
To prevent distillers' wash, or mash, from becoming acid in hot weather, put about two pounds of raisins into one hundred and fifty gallons of the mash, the raisins to be chopped and put into the liquor without a bag, the wash may be let down into the working vat at seventy-five, on eighty degrees of Fahrenheit's thermometer, if the temperature of the place where the working vat may be, does not exceed seventy degrees. One pound of hops should be put into the wash, or mash, vat, for every eight bushels of malt, at the time of mashing, and three-fourths of a pound of hops for every bushel of malt brewed, to be boiled in the liquor in the copper.

JOSIAH STOWELL.

Specification of a patent for an apparatus for the drying of cotton and other articles, and of protecting them from the effects of rain and storms. Granted to JOHN PHILBRICK, *Wilkinson county, Mississippi, February 12th,* 1836.

To all whom it may concern, be it known, that I, John Philbrick of the county of Wilkinson, in the State of Mississippi, have invented an apparatus for the drying of cotton, after it has been picked from the plant, and of a great variety of vegetable and other substances, which require exposure to the sun and air; and by which apparatus they may be immediately protected from the effects of rain and storms; and I do hereby declare that the following is a full and exact description thereof, reference being had to the drawing which accompanies, and makes a part of, this specification.

I erect a staging, consisting of parallel rails, which are to support platforms, troughs, or cars, upon which the cotton, or other articles, to be dried, are to be spread. These cars, or platforms, may be of any convenient dimensions, but for the sake of description, we will suppose them to be made five feet wide, and eight feet long, and the wheels, or rollers, upon which they run, to be six inches in height. In the accompanying drawing one of these rails is marked with the letter C, and rises six inches, or the height of the platform, above the rail upon which it reclines at its left end. P, B, K, L, are platforms, troughs, or cars, which rest and run upon the rails, having wheels, or rollers, upon their under sides for that purpose. The rails upon which the platforms rest, rise one above the other in the form of steps, as seen in the drawing; the platform marked K, is represented as having passed from the right hand rail on to the next platform, having been pushed forward by the man, H, and now stands upon the platform on the next rail, against which it catches, and both pass together under the shed in



the centre, the pair, marked P, being shown as already there. Those at the left hand of the shed are to be slid in, in the same way, when necessary, and pass above the others. I, is a latch, or catch, by which the two platforms are held together, or released, at pleasure. B, are movable steps, for conveniently reaching, charging, and discharging, the platforms.

Although two only of such platforms are represented as extending on each side of the shed, the number to be used is limited only by the convenience with which they may be managed; and this is the case also with their demensions. The mode of managing them also, will admit of being varied, whilst the principle upon which they operate will remain unchanged. Thus, for example, the shed may be made to cover the highest platform, and be itself pushed on, so as to gather all the cars, or platforms, under it, in its progress; the platforms may be in a single row, or there may be two or more rows in width, two being shown in the drawing. The platform may be run under the shed by hand, or by means of a winch with a windlass and ropes, or otherwise.

Having thus fully exemplified the general construction and use of my said apparatus, I wish it to be distinctly understood, that I do not intend, by the examples given, to limit myself thereto, but to vary the same in any way I may think proper, whilst the proposed end is attained by analagous means. What I claim as my invention, is the construction of a rail way, in successive steps, and having upon them cars, or platforms, upon which articles to be dried may be exposed to the sun and air, and which may, in a few seconds, be posited upon each other under a shed, to protect them from the weather when necessary, in the manner, or upon the principle, herein set forth.

John Philbrick.

Progress of Physical Science.

Absorption of light by nitrous acid gas. Sir David Brewster has found that heat so modifies the absorptive power of this gas for the different coloured rays, that while at ordinary temperatures it has an orange colour, by raising the heat it becomes red, and finally black, not a ray of any colour penetrating it. This gas produces in a spectrum formed from artificial light, dark bands analagous to those exhibited by the solar spectrum. By improving the arrangements and methods of observation originally devised by Fraunhofer, of Munich, Brewster has succeeded in detecting two thousand easily recognised portions of the spectrum, separated by thin dark lines, resulting from the absorption of specific rays.

Apparent irregularities in the dark bands of the solar spectrum, were traced to the greater or less proximity of the sun to the horizon, the effect being greatest when the sun sinks below the horizon.

Sir David Brewster infers from a comparison of the lines in the solar spectrum with those produced in the spectrum from artificial light by nitrous acid gas, that the same absorptive elements which exist in the gas also exist in the atmospheres of the sun and of the earth.

Liquid nitrous acid produces none of the fixed lines above alluded to.

Abstract from Lond. and Edin. Philos Mag. May.

Fact in the theory of vision. On the retina and pigment of the eye of the calamary (Sepia Loligo). It will be recollected that an important argument in favor of that theory of vision which assigns the choroid coat and

not the retina as the seat of vision is drawn from the supposed structure of the eye of the cuttle fish. Mr. T. W. Jones has recently made a new dissection and microscopic examination of the eye of the Sepia, in which he finds that the supposed pigment in front of the retina is not really such, but a nervous expansion of a peculiar texture, tinged of a reddish brown colour, a circumstance which has given rise to the error of supposing it merely a pigment. Lond. and Edin. Philos. Mag January.

Fox's dipping needle deflector. This is a compendious instrument for determining the magnetic dip, intensity, and variation, invented by R. W. Fox, Esq. of Falmouth, England. It consists of a dipping needle accurately poised on an axis passing through the centre of gravity, to be deflected from the position of the dip by two bar magnets fitting into tubes attached to the back of the instrument, and the tubes being capable of motion round the axis of the needle so as to produce a greater or less proximity of the magnets to the poles of the needle. The needle having first been brought into the plane of the meridian, the approximate dip is obscured while the bar magnets or deflectors are not in place. The plate to which the deflectors are screwed is then moved to make a convenient angle with this dip and the magnets inserted the north pole of one near the north pole, and the south pole of the other near the south pole, of the dipping needle. The needle is thus deflected to a certain angle which is measured. The deflectors are then moved by moving the plate which carries them until they make the same angle with respect to the first dip, but on the opposite of it. The needle is thus again deflected, but in the opposite direction, and the half sum of the observed angles is the dip. By varying the position of the deflectors several observations may be obtained on different parts of the limb of the instrument, and, with a greater or less leverage, in the force of terrestrial magnetism. The relative intensities are observed by the amount of deflection produced by the magnets at a given angular distance from the line of dip, or by weights placed upon a flexible cord passing over a wheel attached to the axis of the needle, either with or without the use of the deflectors. A telescope attached to the plate or arm, carrying the deflectors, serves to determine the variation by a star, or by the image formed by a lens upon a plane of plaster of Paris, when an observation of the sun on the meridian is preferred. The readings of the vertical circle on which the needle plays are made accurate by a second graduated circle, placed near to the front of the box and of course between the eye and the needle. Verniers are provided for reading the angle of the deflectors and the azimuths. The instrument is provided with the usual means of levelling. When packed, the magnets form a circuit, with a view to a permanent condition in the several needles, or bars. Ann. Rep. Cornwall Polytech. Soc.

On the electrical relations of certain metals and metalliferous minerals.—Mr. R. W. Fox finds that the crystalized grey oxide of manganese, holds a much higher place in the electro-negative scale than any other body with which he has compared it, when immersed in various acids, and alkaline solutions. This and some of the other bodies examined by him, rank thus: 1, manganese; 2, rhodium, loadstone, platinum, arsenical pyrites, plumbago, nearly equal; 3, iron pyrites, copper pyrites nearly equal to the second; 4, salina; 5, standard gold; 6, copper-nickel; 7, silver; 8, copper; 9, sheet iron. Extract from Trans. Royal Soc. Lond. 1835.

On the properties of liquid carbonic acid. According to M. Thilorier, this liquified gas presents the strange and paradoxical fact of a liquid more expansible than the gases themselves: from 32° to 86° Fahr., its volume

increases from 20 to 29, that is to say, that at 86° Fahr., the increase of volume is nearly equal to half the volume at 32° Fahr. Its expansion is four times greater than that of atmospheric air, which from 32° to 86° Fah. only expands $\frac{30}{267}$, whilst the expansion of liquid carbonic acid on the same scale is $\frac{116}{267}$. If the temperature of a tube containing a portion of liquid carbonic acid is raised, this liquid boils, and the empty space above the liquid is saturated with a greater or less quantity of vapour according to the elevation of the temperature. At 86° Fahr., the quantity of liquid at 32° Fahr. sufficient to saturate the empty space, is represented by a portion of liquid equal to one third of the space in which the vaporization has been effected. At 32° Fahr. the portion of liquid of saturation is only $\frac{1}{12}$ of the space saturated.

The pressure of the vapour formed by the liquified gas from 32° to 86° Fahr., amounts from 36 to 73 atmospheres, which is equivalent to an increase of one atmosphere for every centigrade degree. It is important to observe that the weight or density of the vapour increases in a much greater proportion than the pressure, and that the law of Mariotte is no longer applicable within the limits of the liquefaction. If the density of the vapour is taken for the base of the pressure, the pressure at 86° Fahr. will be equal to 130 atmospheres, whilst the manoscope will only indicate 73 atmospheres. If a tube of glass containing a portion of liquid and a portion of gas be heated, two contrary effects will take place:

1st, the liquid will augment by expansion;

2nd, the liquid will diminish by vaporization.

The thermoscopic effects are very different according as the portion of liquid is greater or smaller to the portion of gas; the liquid in the tube will either expand, contract, or remain stationary. These anomalies furnished the means of verifying the numbers which the preceding researches had given on the expansion and vaporization. According to these numbers, the points of equilibrium above which the liquid increases, and below which it diminishes on the addition of heat, result from such a proportion when empty or full, that at zero the liquid occupies $\frac{13}{30}$ of the whole tube. If the liquid at 32° Fahr. occupies one third of the tube it seems as a retrogade thermometer, of which the liquid increases by cold, and diminishes by heat. If the liquid at 32° Fahr. occupies two thirds of the tube it acts as a regular thermometer; that is to say, the liquid increases and diminishes according to the laws of expansion. This thermometer is limited at 86° Fahr. as at this temperature the tube is entirely filled by the liquid.

The specific gravity of this liquefied gas at 32° is 0.83, water being 1. It presents the singular phenomenon of a liquid which from — 68° to + 86° Fahr., runs through the scale of densities from 0.90 to 0.60. It is insoluble in water, with which it does not mix; but is soluble in alcohol, æther, naphtha, oil of turpentine, and sulphuret of carbon, in every proportion; it is decomposed in the cold, with effervescence, by potassium; it does not act sensibly on lead, tin, iron, copper, &c.

When a jet of liquid carbonic aid is directed upon the bulb of an alcohol thermometer, it falls rapidly to — 194° Fah.; but the frigorific effects do not correspond with this decrease of temperature, which is accounted for by the almost absolute want of conducting power, and the little capacity for heat, of the gases; therefore the intensity of the cold is enormous, but the sphere of action is limited in some measure to the point of contact. If the gases have little effect in the production of cold, such is not the case with the vapours, of which the conducting power and the capacity for heat are

much greater. If æther, for instance, could be placed in the same conditions of expansion as the liquefied gas, a much greater frigorific effect would be obtained than by liquified carbonic acid. To accomplish this object it is necessary to render æther explosive, which is easily effected by mixing æther with liquid carbonic acid. In this intimate combination of two liquids which dissolve one another in every proportion, the æther ceases to be a liquid permanent under the pressure of the atmosphere; it becomes expansive similar to a liquefied gas, at the same time preserving its properties as a vapour; that is to say, its conductibility and capacity for caloric.

The effects produced by a tube filled with explosive æther are remarkable; a few seconds were sufficient to congeal 722 grains of mercury in a glass vessel. On exposing the finger to the jet which escapes, the sensation is intolerable, and seems to extend much further than the point of contact.

M. Thilorier intends to replace æther by sulphuret of carbon; and it is probable that the effects obtained will be still more powerful.

Annales de Chimie. et de Phys and Lond. and Ed. Phil. Mag.

Solidification of Carbonic Acid. M. Thilorier has read to the Academy of Sciences a memoir containing an account of the means by which he rendered carbonic acid solid; and he also gave some details respecting liquid carbonic acid.

He finds the finds the specific gravity of the liquid acid to be .83, water being 1.; it dissolves in all proportions in alcohol and æther: potassium decomposes it, but the common metals do not. A jet of carbonic acid, directed upon a spirit thermometer, caused it to fall 194° below zero Fahr. The cold would have been still greater if the bulb of the thermometer could have been entirely covered by the jet.

The solidification of carbonic acid was effected in the following manner: a jet of liquid carbonic acid was received in a glass vial; the expansion of which it undergoes is about 400 times its original volume, and by this so intense a cold is produced, that one part of the carbonic acid congeals in a white powder and adheres to the glass. This powder exists for some minutes, and without any pressure. If the finger be placed in solid carbonic acid, the heat converts it into gas, the expansion of which repels the finger. A few grains of this powder, closed in a vessel, soon expelled the cork.

Solid carbonic acid contains a little water, which is doubtless derived from the moisture of the air. In order, however, to remove all doubts, it would be necessary to get rid of the hygrometric moisture, both of the air and of the vessels, because it might be supposed that this water facilitates the congelation of the acid, as is the case with chlorine.

As to the temperature of this congelation, it was determined by using a spirit thermometer graduated to 187° below zero, to which about 44° must be added for the tube of the thermometer which could not be cooled, so that the cold observed was not less than 231°*.

These experiments were verified by commissioners, among whom were MM. Thenard and Dulong.

Journal de Chim. Med., tome ii. p. 3, and Lond. and Edin. Philos. Mag.

Water of the Elton, Dead, and Caspian Seas.† The Elton sea lies to the east of the Volga, 274 versts ($181\frac{1}{2}$ miles), south from Saratov. Its greatest diameter, from east to west, is 17 ($11\frac{1}{4}$ miles), and its smallest diameter 13 versts, ($8\frac{1}{2}$ miles).

* These are lower temperatures than have ever before been artificially produced, and lower also, we believe, than any which have yet been observed in nature.—Ed.

† Poggendorff's Annalen xxxv. 169.

The specific gravity of the water, at 53½°, is 1.27288, according to Rose. Its contents are, according to Rose and Erdmann:—

	ROSE.	ERDMANN.
Chloride of sodium,	38.3	71.35
Chloride of potassium,	2.3	
Chloride of magnesium,	197.5	165.39
Sulphate of magnesia,	53.2	18.58
Sulphate of lime,		.36
Sulphate of soda,		3.84
Carbonate of magnesia,		.38
Water and organic matter,	708.7	740.10
	1000.0	1000.00

When the temperature of the sea falls, Epsom salt precipitates. Here it is evident that the specific gravity and composition must change with the temperature. The shore of the Elton sea exhibits, in summer, crystals of gypsum and common salt; and, in winter, besides these, Epsom salt, which, in summer, is again dissolved, so that pure common salt may be obtained here. In the cool summer nights, according to Pallas, Epsom salt is deposited, and is again dissolved during the day. The greater the quantity of chloride of magnesium and Epsom salt, so much the less is there of common salt; which, from the elevation of the temperature, dissolves in no greater quantity in the same. Hence, the reason for the small quantity of common salt which Rose obtained. When an analysis of such a saturated water is given, it is absolutely necessary to give the specific gravity and the temperature. The reasons given are sufficient to account for the difference in the two analysis.

Erdmann found the constituents of the Bogden sea,

Sulphate of lime,	.74
Sulphate of magnesia,	10.30
Sulphate of soda,	215.76
Muriate of lime,	8.85
Muriate of magnesia,	48.53
Water,	715.72
	1000.00

The water of the Elton sea resembles that of the Dead sea, but the latter has a less specific gravity, and a smaller quantity of solid constituents. The quantity of salt diminishes when the Jordan is overflowed. Gay Lussac allowed the water to cool to 19° F. without separating any salt: while Klaproth states, that at the bottom of the flask which contained the specimen which he examined, crystals of common salt were deposited, which soon disappeared. The specific gravity of the Dead Sea varies, and the reason is obvious. Macquer, Lavoisier, and Sage found it 1.240; Marcet and Tennant 1.211; Klaproth 1.245; Gay Lussac at 62°.6, 1.2283; Hermbstadt at 60° 1.240. The proportion of ingredients also varies. Gay Lussac found them 26.24 per cent.; consisting of chlorides of sodium, calcium, magnesium, and potassium, and traces of gypsum, differing from that of the Elton Sea by the absence of Epsom salt, and the presence of chloride of calcium.

According to Marcet, the specific gravity of the water of the Sea of Urmia is 1.16507, and its constituents 22.3 per cent, consisting of common salt, Epsom salt, and sulphate of soda. The saline contents of Urmia and

the Dead Sea are, therefore, inferior to those of the Elton Sea. Rose has appropriated all the sulphuric acid to the magnesia, because he has found that when common salt and Epsom salt are dissolved in a sufficient quantity of water and evaporated in a summer heat, the two salts separate; and when much common salt is dissolved along with a small quantity of Epsom salt, a part of the common salt separates first, and then the Epsom salt, while common salt remains in solution; as by the heat of summer, Epsom salt is less soluble than common salt. When the temperature is raised above 122° F. or sunk to zero, in both cases, glauber salt and chloride of magnesium are formed.

Rose found the specific gravity of water brought from the Caspian Sea 75 versts from the islands formed by the Volga, at 54½°, 1.0013; and its contents,

Chloride of sodium, ...	.754
Sulphate of soda, ...	.036
Sulphate of lime, ...	.406
Bicarbonate of lime, ...	.018
Bicarbonate of magnesia, ...	.440
Water with a small quantity of organic matter, .	99.348
	1000.000

Record Gen. Sc. February.

Rationale of cold produced by sulphate of Soda and muriatic acid. Doct. Kane makes the following statement in a paper on the action of muriatic acid on the sulphates. "It has been long known that Glauber's salt treated with muriatic acid constitutes a powerful freezing mixture, the theory of which is at once explained by the results of the experiment. When sulphate of soda is dissolved in liquid muriatic acid there are formed bisulphate of soda and chloride of sodium, and as the former salt crystalizes with only four atoms of water, the remaining quantity of the water of crystalization of the Glauber's salt, is disengaged to the amount of sixteen atoms." "This large quantity of water suddenly separated from a state of combination in which it had been solid, produces, by its absorption of caloric of liquidity, the frigorific property." Lond. and Edin. Philos. Mag. May.

Progress of Practical and Theoretical Mechanics and Chemistry.

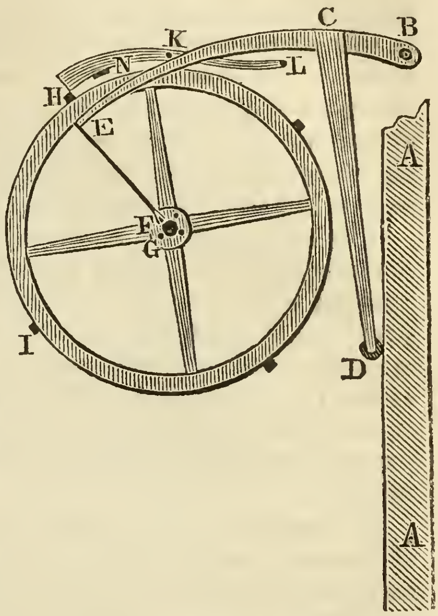
*Description of a new Detached Pendulum Escapement, invented by Alexander Witherspoon, watch-maker, Tranent.**

A, is the pendulum rod, represented as having nearly reached the limit of its vibration to the left, and as about to touch the small friction roller attached to the arm C D of the impeller B C D E. The upper part of the pendulum rod is broken off to show the axis B, concentric with the axis of motion of the pendulum itself, on which the impeller turns. The two axes coinciding in direction, no rubbing ought to take place though there were no friction roller at D; the roller is merely placed there for the purpose of preventing the bad effects of any small error in the adjustment. In the drawing, the weight of the impeller is represented as sustained, through the intervention of the slender spring E F, by the lifting pin F, which is placed near the centre of

* Read before the Society of Arts, 13th April, 1831.

the scapement wheel; this wheel itself being prevented from advancing by the opposition of the detent to the detaining tooth H. The end of the spring E F is furcated, the pin resting in the bottom of the notch, and keeping the spring bent upwards from its natural position by a distance rather more than the minute diameter of the pin.

The oscillation of the pendulum is so nearly completed, that, when finished, the impeller B C D E may be lifted till the extremity of the spring just escapes from the pin F, and takes up a position a little to the left of its present one. The whole weight of the impeller now rests upon the pendulum; but when the pendulum begins to retire, the extremity of the spring is not arrested by the pin F, but passes close by it, directing its motion towards the pin G.



The impeller continues to press against the pendulum rod, and increases its momentum until the arm B E reaches a pin at L, projected from the branch of the detent H K L. After this the pendulum continues its oscillation uninterrupted.

The detent turns upon an axis at K, so that the pressure of the impeller upon the pin L elevates the detent, and allows the detaining tooth H to pass forward.

Just at this moment the second lifting pin G is entangled between the sides of the notch in the extremity of the spring E F; the motion of the wheel, therefore, again elevates the impeller, the rise of which allows the detent to descend upon the stop N and await the arrival of the second detaining tooth I, whose arrest is announced by a distinct beat.

The whole of the escapement has now assumed a position exactly analogous to that which it had at first, and awaits the approach of the pendulum, to solicit anew its maintaining power.

During the whole of this action the pendulum is never connected with the train of wheels. The only body which acts upon it is the impeller, and this communicates to it the impulse which is generated by a descent of a constant weight through a determinate distance. The lightness of the parts renders oil either on the axis B or on the pin F unnecessary, so that this action is entirely freed from any error which might have arisen from changes in the adhesiveness of oil. In order to solicit the impulsion, the pendulum has to raise the impeller through a distance determined by the thickness of the pin F, and has to overcome the friction of the spring against that pin. But the diameter of the pin is so small and the flexure of the spring so slight, that the errors caused by them must be exceedingly small, especially when we consider that they are not liable to any variation. The unlocking of the detent H, instead of being performed by the pendulum, is effected by the impeller; so that, however variable may be the maintaining force, provided it is never so small as to be unable to raise the impeller, nor so great as to prevent the unlocking of the detent, the going of the clock can never be in the slightest degree affected.

When the pendulum rod reaches the friction-roller, it is moving with a

very small velocity, since it is almost at the limit of its oscillation, so that nothing analogous to the blow of the common 'scapements takes place; and even the sudden removal of the pressure of the impeller, when the arm reaches the pin L, can hardly excite any tremour in the pendulum.

In almost all delicate escapements, high finish in the rubbing surfaces and great accuracy in the workmanship, are absolutely essential to good going. In every case the advantage of careful execution cannot fail to be felt; but in this escapement that advantage is by no means great. The execution of the train is almost a matter of indifference; and even in the most vital part, though the distances of the detaining teeth were inaccurately laid off, the errors would occur at every revolution of the escapement wheel, and their effects on the going would be generated and destroyed in the same period, so that the daily or hourly rate could not be affected.

The motion of the train resembles that of a perfect dead-beat, although the escapement certainly partakes of the nature of the recoil, since the unhooking of the spring is only effected after a slight elevation of the impeller. The beat is made only at each second oscillation, so that, in order to beat seconds, a half second pendulum must be used. In escapements which beat at each vibration, it is difficult to have two consecutive intervals exactly equal,—the one being less, and the other as much more than an exact second; but when the beat is given only on one side, no such inequality can exist.

The parts of the impeller are liable to expansion by heat, but the effects of this can easily be obviated by extending an arm made of some expansive metal such as zinc, on the other side of the axis B, while the branches represented in the figure are made of glass. This arm also will allow a weight to be slid along it so as to regulate the intensity of the impulse.

When the spring is released from the pin F, it does not merely assume its position of rest, but continues for a moment to vibrate on each side of it. As there might appear to be some risk of its catching again the same pin, a damper has been put on to diminish these oscillations; but, as in some other escapements which I have constructed on the same principle, it was not found necessary; it has been omitted in the drawing. I need hardly point out that the number of lifting pins is not limited to four. Jameson's Journal.

Capillary Tubes in Metal. The sum of five pounds was presented to Mr. J. Roberts, 64 Queen Street, Cheapside, for his method of subdividing a pipe into capillary tubes; a specimen of which has been placed in the Society's Repository. The thanks of the Society were voted to Hen. Wilkinson, Esq. Pall Mall, for his method of producing a ring of capillary tubes. For gas-burners, for the safe combustion of mixtures of oxygen and hydrogen, and for other purposes, it is often desirable to divide the end of the discharge-pipe into fine capillary tubes, of the depth of half an inch or more. It is difficult and expensive to bore such apertures in a piece of solid metal, and it is hardly possible to be executed at all if the apertures are required to be of very small diameter.

Mr. Roberts very ingeniously and expeditiously subdivides the end of a metal pipe into small tubes of any required depth, by means of pinion-wire. Pinion-wire is made by taking a cylindrical wire of soft steel, and passing it through a draw-plate of such a figure as to form on its surface deep grooves in the direction of radii to the axis of the wire: the ribs which separate these grooves from one another may be considered as leaves or teeth, and of such wire, when cut into proper lengths, are made the pinions used by watchmakers. Hence arises the name by which this wire is commonly known.

If now a piece of this wire be driven into the end of a brass pipe of such a size as to make a close fit with it, it is evident that that part of the pipe has thus been subdivided into as many smaller tubes as there are grooves in the wire. By using a draw-plate fitted to make smaller and shallower and more numerous grooves than are required in common pinion-wire, it is manifest that wires or cores may be produced, which, when driven into metal pipes, as already described, will subdivide them into capillary tubes of almost any degree of tenuity.

Mr. H. Wilkinson's method is described in the following letter:

Pall Mall, May 25th, 1835.

Sir, In the course of some experiments on artificial light, which I was engaged in about twelve months since, I was desirous of obtaining a great number of extremely minute apertures for a gas-burner; and, finding it impossible, in the ordinary way, to obtain them, a new method occurred to me, which immediately produced the desired effect. I showed it at the time to several eminent scientific men, who were unable to conceive how these apertures were formed; and, as I made no secret of the method, they were equally pleased at the simplicity of the operation; and the specimen herewith sent has been exhibiting at the Gallery of Practical Science for several months. I did not attach much importance to it myself; but, as I do not find that it is at all known, and now think it might be useful in a variety of ways, I have sent it to you to be laid before the Society; and should they be of the same opinion, I shall feel much pleasure in communicating the mode of operation, by which any number of apertures, hardly visible to the naked eye, and of any length (*even a foot, if required*), may be made in any metal in *ten minutes!*

I am, sir, &c. &c.

Henry Wilkinson.

A. Aikin, Esq. *Secretary, &c.*

The process consists merely in turning one cylinder to fit another very accurately, and then, by milling the outside of the inner cylinder with a straight milling tool of the required degree of fineness, and afterwards sliding the milled cylinder within the other, apertures are produced perfectly distinct, and of course of the same length as the milled cylinder. A similar effect may be produced on flat surfaces, if required. H. W.

Trans. Lond. Soc. Arts.

Duty of Cornish Steam Engines. The mode of estimating the performances of steam-engines, *by the number of lbs. lifted one foot high by the consumption of a bushel of coal*, was introduced into Cornwall by Watt, when it became requisite to keep a regular account of the work done and the coal consumed, for the purpose of calculating his share, which was one-third of the saving of coal effected by his engine in comparison with Newcomen's.

The performance of two atmospheric engines, at Poldice, had been ascertained as a standard of comparison, and declared by a committee: for convenience the present dynamic unit was afterwards adopted, and the work done when thus expressed was equal to 7,037,800 lbs. lifted one foot high by each bushel of coal. A dispute arose in 1798 between Messrs. Boulton and Watt and the mining adventurers in Cornwall, and it became necessary to ascertain the average duty, which was proved to be 17,671,000 lbs.: this was rather less than in 1793, when the average of seventeen engines was 19,569,000 lbs. After the expiration of the patent in 1800, no

accounts were kept of the work performed by the engines under the direction of the mining engineers.

In August, 1812, the average duty of several engines on a month's trial proved to be only 13½ millions, and the truth of the prevailing opinion became apparent, that less work was done than during Watt's patent. The present monthly report of 'work performed' was then established under the management of Mr. Lean, and since his decease has been conducted by his son, so that there exists a series of reports for twenty-two years, showing the duty for each month, of the engines employed in Cornwall, including the size of the pumps, and their depths, number of strokes, bushels of coal consumed, &c. &c.; a reference to which would point out at what period, and by whom, every increase of duty was obtained.

Woolf introduced the use of high pressure steam worked expansively in two cylinders, and first succeeded in performing fifty millions. Other engineers worked high steam expansively in one cylinder, which plan became general on the introduction of Trevithick's cylindrical boilers.

Several engines now constantly perform a duty exceeding 70 millions, double that of the best of Watt's, and of which one has reached 91,200,000; another mentioned last meeting by our President, averages about 90,000,000; its best performance was 97,800,000, for one month.

Part of the increase of duty must be attributed to the improved pitwork; the most rapid increase, however, took place on the introduction of a most complete system of *clothing*, the present practice of which is so efficient, that in two instances, though the steam in the *jacket* was at least 270°, the outside casing did not exceed 78°;—the thermometer was covered by a silk handkerchief to prevent the draught of air in the engine-house affecting the results;—the air outside was in one experiment 56°, and in the engine-house about 66°;—the surface of the ashes over the boilers was about 90°."

Ann. Report Cornwall Polytech. Soc.—Lond. Mech. Mag. April.

Progress of Civil Engineering.

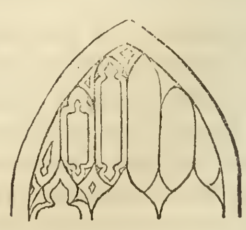
Observations on the Classification and Details of the Architecture of the Middle Ages. By E. B. Lamb, Esq. Architect.

(continued from p. 141.)

The Third Class commenced about 1377, and continued till 1460. In the first division of this class the equilateral arch was given up for one struck with two centres, of an obtuse form, which was much used with the four-centred arch (*Fig.* 11,). The window heads were filled with tracery in the perpendicular lines (*Fig.* 12,) the predominating character of the whole of this class, and the mouldings, became gradually more complex. The windows, for some time, retained the simple arch, the

Fig. 11.

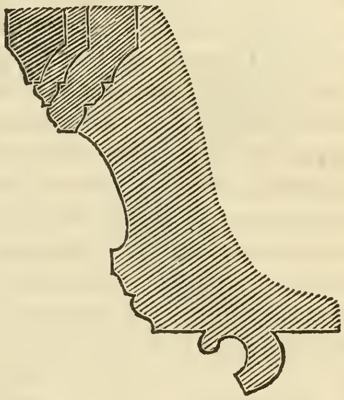
Fig. 12



compound arch only being used in small openings. Windows were divided in their height by transoms, and sometimes columns were added to mullions. *Fig.* 13, is a selection of a small window jamb, at Ifly Church, which shows the general character of the mouldings of the second division of this class. *Figs.* 13, 14, 15, 16, 17, all resemble each other, and mark the distinctness of the mouldings from those of the second class. In these sections it will be observed, that, although the mullions do not, in a very great degree, appear to differ from the mullion mouldings of the second class, yet the extended hollow moulding in

Fig. 13.

Fig. 14.



the jamb is perfectly in character with the depressed simple, and also with the compound, arch. It is very different from the easy flowing lines of the second class; and the mullions, though they appear, as I before mentioned, to resemble those of the other class, upon closer examination will be found generally to be of a more bulky character. The elegant flowing lines of the second class are, indeed, in no instance to be seen in this, and the expression is of a widely different nature; for,

Fig. 15.

Fig. 16.

while the former indicated a graceful undulating character, without interruption, the latter is expressive of a degree of abruptness and crispness peculiarly its own: at least, these are impressions made upon me by these two classes; and they appear to arise from the obvious difference in the expression. A profusion of heraldric devices were among the principal decorations of this period. Among the examples of this class are, of the first division, New College Chapel, Oxford; a window in Westminster Hall; and the west door of St. Saviour's Church, which is a fine specimen of the middle division; a window in St. Peter's Church, Oxford, of which *Fig.* 14, is the section of the jamb; also Merton College Chapel, Oxford, 1424; and King's College Chapel, Cambridge, 1443. Of the latter, or transition, division of this class, may be mentioned the Chapel on the Bridge, Wakefield, Yorkshire.

The Fourth Class, is a continuation of the same general forms, from 1460 to about 1547. The mouldings, arches, ornaments, &c., were now wrought to a greater degree of richness; and the most delicate work was bestowed on canopies, nitches, groinings, and, in fact, on every part, the principal aim appearing to be to produce stone carving of a net-like character, rather than to preserve good composition by agreeable contrasts. The result of this lavish display of ornament ended in a generally depraved taste, and the consequent decline of the art. Examples of this class will be found in Magdalen College, Oxford, about 1473; centre tower of Canterbury Cathedral, about the same date; St. George's Chapel Windsor, 1481; and Henry VII's Chapel, Westminster, about 1503. In Henry VII's Chapel, and, in fact, in many of the buildings of the fourth class, we can trace a general decline in art, without alluding to the wearisome richness, which becomes fatiguing to the eye for want of repose. I have no doubt I lay myself open to much reproof for presuming to differ from the accepted opinion with regard to this class of architecture; but I think I need only refer to the exterior of Henry VII's. Chapel in vindication of my assertion. This exterior is cut into so many small parts, that there is scarcely any situation from which a pleasing view of it can be obtained; and the principal charm which it possesses in point of effect is borrowed from its contrast with the Abbey: the whole exterior, in short, is a multiplicity of angular projections, which throw no shadow, and, consequently, produce no relief. The interior is much better: the effect here is good; the light and shade, being distributed from the large clerestory windows, are more pleasing; and the fan-groining and pendants of the nave and aisles produce a rich effect: but, still, I cannot see the beauty of these angles and curves, even in the interior; though they are certainly better here than on the outside.

Fig. 17.

In the latter division of this class, the mouldings and mullions were changing their pure form, and becoming mixed with the Italian architecture, which was, about this time, making great progress in the formation of that mongrel style now called Elizabethan; and many examples of this transition work are to be seen in Oxford, Cambridge, and London. Eastbury House, Barking,

in Essex, is a fine specimen of the brick buildings of the early part of the reign of Henry VIII., and contains more pure mouldings than most of the other buildings of that time: it is built entirely of brick work; mullions, transoms, and the most delicate ornaments, being all executed in brick. *Fig.* 18, is a section of one of the window jambs and mullions. *Fig.* 19, is a section of a mullion and jamb of the transition character. In this figure it will be seen that the jamb mouldings are a hollow and ovolo, and that the mullion is a fillet on one side: the other side, in the same section, is to be seen in the second class occasionally.

Fig. 18.

Fig. 19.

The Elizabethan architecture now became the prevailing style, and continued to hold its rank until Inigo Jones succeeded in changing the public taste in favor of what was then called the perfect Italian style.

The characteristics of the Elizabethan style, are the regular entablatures, columns, pedestals, and arches of Italian architecture, interwoven with the pointed arches, enriched spandrils, heraldric devices, and other decorations of the Gothic. Orders were used over orders, and in situations where they were placed in direct violation to all reason. In one of the Colleges at Oxford, the whole of the five orders are piled one above another in one narrow front. These entablatures and columns were adorned with the most clumsy devices; such as scrolls abruptly terminating in angles, carvings of vegetables in bunches, &c., and buildings being surmounted with obelisks, balls, scrolls, and numerous fantastic devices, without the least reason being shown for their use. In some instances, this style has a very picturesque effect; and, when a sufficient excuse can be shown for its introduction in public buildings, that is the time, and the only time, where it should be introduced; but national buildings should be in a more perfect style. The bad taste shown by the building committee for the Houses of Parliament, in recommending this style of architecture for their Senate House, must be obvious to every person who is the least acquainted with its details: there is ample scope for talent in the pure Gothic style; therefore, why revive a style which only marked the decline of the art?

It only remains for me now to say a few words relative to the Gothic mullion. Windows are divided into lights by mullions of various sizes and sections; and each window consists of an outer arch, or frame, the jamb or architrave mouldings of which are perfectly distinct from the mullion, or column. Mullions are divided into orders; and the small mullion, which generally consists of a hollow and a fillet, or of a splay and fillet, is the first order: it is from this order that the cusps spring in every class; and for that reason it is sometimes called the casp mullion. Windows of two, three, and some-

times more, lights, have only one order of mullions, particularly windows of the second class; and this single order is continued through the whole of the ramifications of the window head. An increase of strength and richness was produced by the introduction of the second order of mullions; and this was obtained by increasing the thickness of the first order, and adding another moulding to the fillet; which, from the increased thickness, required something to fill up the fillet, and, at the same time, to add to its strength. *Fig.* 2, will show the two orders of mullions of the first class. These had different offices assigned to them: thus, the first order, being the smallest, formed the smallest composition; the second order, from its increased size, formed the larger divisions of the window; and so they might proceed to a third, fourth, fifth, &c., each successively growing out of the other: and the window, *Fig.* 3, will show their application. I need scarcely say, that the largest order of mullions contains all the others, so that the smallest goes round the whole of the window head. *Figs.* 5, 7, show only one order of mullions; *Fig.* 2, shows two orders of the first class; *Fig.* 9, shows three orders of the second class, the first of which is the tracery or cusp mullion; *Fig.* 10, shows one order. It will be observed that the tracery mullion is the same in every window in these figures; and that, though there are instances of two orders being used in tracery, even then the cusp proceeds always from the first order. The cusp rises out of the hollow of the first order, and, in the first class, frequently terminates with a flower, and sometimes square, in the second class it is formed, generally, by the intersections of two segments of circles, but is sometimes square, or a kind of blunted point; and, in the third and fourth classes, it terminates in an angle, and sometimes a flower is attached to it. These rules are not without exceptions; for the artists who could produce such wonderful combinations as are to be found in the architecture of the middle ages, so full of variety and originality in every class, would not be restrained, in the flights of genius, to the same forms or ornaments throughout the same building; and, in every building we examine, we find something to add to our stock of knowledge which we never dreamed of before.

In tracing the change of mullions through the different classes of Gothic architecture, it is curious to observe, that the mullions of the fourth class have been continued down to the present day in our sash bar. In Queen Elizabeth's time, windows were divided into a greater number of lights with transoms; in king James the First's time, they became still more numerous in their divisions, but the mullion was not so bulky; and by degrees the windows had as many transoms as mullions, while every fresh complication of mullions and transoms produced a decline in the thickness; and even the general introduction of the Italian style only tended to decrease the thickness of the mullion, but not to alter its general form.

Fig. 20.

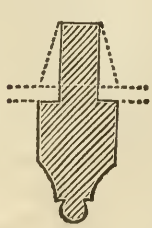


Fig. 21.

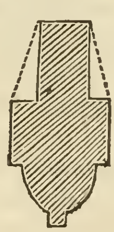
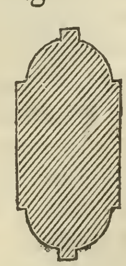


Fig. 22.



I am not aware of the exact time when the lines and weights for windows

were first introduced; but when they were known they soon became very general, and, I have no doubt, assisted in the reduction of the mullion, which continued to dwindle to what are now called the ovolo, and the astragal and hollow sash bars. *Figs.* 20 and 21, will show these sections. *Fig.* 22, is the section of the mullion of Queen Elizabeth's reign. The great demand for novelty in the present day, and the use of large squares of glass, have been the means of producing new forms, which are so very thin as to be scarcely visible: these are designated by the titles of lamb's tongue, and the bevel bar.

In the foregoing remarks I have endeavored to give a classification of the architecture of the middle ages, very imperfectly, I am aware; but if these observations should induce some one to institute a fuller enquiry into the architecture of this country, and if my remarks should be of the least service to the general reader, in assisting him to find the cause which produced the great effects in the edifices of our forefathers, it will be a gratification to think that I have not studied in vain.

Henrietta Street, Brunswick Square, August, 1835.

On the Expansibility of different kinds of Stone. By Mr. Alexander J. Adie, Civil Engineer.—"This paper contains the results of an extensive series of experiments made upon different kinds of stone, as well as upon iron and upon brick, porcelain, and other artificial substances. The instrument employed was a pyrometer, of a simple construction, capable of determining quantities not greater than $\frac{1}{30000}$ of an inch. The length of the substances generally employed was 23 inches. The general result of these experiments is, that the ordinary building materials of stone expand but very little differently from cast iron, and that, consequently, the mixture of those materials in edifices is not injurious to their durability. The experiments from which the expansibility of the substances was numerically determined were made between the limits of the ordinary atmospheric temperature and that of 212°; steam being introduced for that purpose between the double casing of the instrument. The following results were obtained for the fractional expansion of the length, for a change of temperature of 180° Fahr.:—

Table of the expansion of Stone, &c.

	Dec. of length of 180° Fahr.
1. Roman cement,	.0014349
2. Sicilian white marble	.00110411
3. Carrara marble,	.0006539
4. Sandstone from the Liver Rock of Craigleith Quarry,	.0011743
5. Cast-Iron from a rod cut from a bar cast 2 in. square,	.00114676
6. Cast-Iron from a rod cast half an in. square	.001102166
7. Slate from Penrhyn Quarry, Wales,	.0010376
8. Peterhead red granite,	.0008968
9. Arbroath pavement,	.0008985
10. Caithness pavement,	.0008947
11. Greenstone from Ratho	.0008089
12. Aberdeen grey granite,	.00078943
13. Best stock brick,	.0005502
14. Fire brick,	.0004928
15. Stalk of a Dutch tobacco-pipe,	.0004573
16. Round rod of Wedgewood ware (11 in. long)	.00045294
17. Black marble from Galway, Ireland,	.00044519

Proceedings of the Royal Society of Edinburgh. Jameson's Edin. New Phil. Journal.

Soap from Flints. Mr. Sheridan takes the common black flint, calcined, and reduces it to powder by wet-grinding; then mixes it with the caustic soda leys, or potash leys, and boils it till it attains saponification. The mixture so obtained* is added to the present soap materials after the latter have been boiled to that state when they have become soap, and are ready to be poured into the frames. The mixture, which has a high detergent quality, requires to be well crutched along with the soap materials; and when thus crutched together, the result is a soap of excellent quality. The mixture becomes intimately incorporated with the soap materials, and may be added in proportion of from 40 to 50 parts of the mixture to 50 of the soap materials. Thus the common silex, which is obtainable at a very low price, takes the place of tallow to the extent of nearly one-half. Lond. Mech. Mag.

Comparative table of Speed. From the Physical and Chemical Journal of Science, and the Arts of Husbandry in France, we make the following extract, which will be found no less curious than useful, and cannot fail to interest our readers:

	Feet per second.
The ordinary rate of a man walking, - - - -	4
Of a good horse in harness, - - - -	12
(Or 2,000 toises (yards) in 8 minutes).	
Of a raindeer in a sledge, on the ice, - - -	26
Of an English race-horse, - - - -	43
Of a hare, - - - - - -	88
Of a man casting a stone with all his force, -	60†
Of a good sailing ship, - - - - -	19
Of the wind, - - - - - -	82
Of sound, - - - - - - .	1,038
Of a cannon-shot (24-pounder) - - -	1,300
Of the air which returns into space so divided, -	1,300

Lond. Farmers' Mag.

List of American Patents which issued in June, 1836.

	June.
380. *Oven.*—Wm. H. Atkins, Berkshire, N. Y.	2
381. *Cooking stove.*—E. G. Currier, Warner, N. Y.	2
382. *Cooking stove.*—E. G. Currier, Warner, N. Y.	2
383. *Plough.*—Jacob Plank, Carlisle, Penn.	2
384. *Generating light and heat.*—Horace L. Barnum, N. Y.	2
385. *Granite dressing machine.*—J. D. Buzzell, Cape Elizabeth, Maine,	2
386. *Cylindrical breaker.*—Smith Cram, N. Y.	2
387. *Chopping meat.*—J. Masser and S. Smith, Mayerstown, Penn.	2
388. *Smut machine.*—Robt. Engle, Burlington city, N. J.	2
389. *Stove for anthracite.*—Adrian Jones, Hartford, Conn.	2
390. *Blast furnace.*—Benjamin Kugler, Philadelphia,	2

* The compound here alluded to is a combination of silica (silex) and potassa (potash), and is frequently called liquor of flints. Silica is a body still generally ranked with the *earths*, which it resembles in many points, but it is, in its chemical relations, an *acid*, combining with alkalis, and forming salts, which are called silicates. It may be considered a curious fact, if the above statement be correct, that this weak mineral acid should be able to take the place of the weak animal, or vegetable, acids united with alkalis in ordinary soaps. B.

† We believe this calculation to be incorrect. A stone cast with the strength of a man's arm will outstrip a hare.

391. *Thrashing machine.*—Jacob S. Rollins, New Gloucester, Maine, 2
392. *Mowing machine.*—Henry Allen, Fayetteville, Tenn. 2
393. *Water wheel.*—Henry Allen, Fayetteville, Tenn. 2
394. *Pump, frictionless.*—Edward Whitfield, N. Y. 2
395. *Hemp &c. spinning.*—Moses Day, Roxbury, Mass. 2
396. *Clover cleaning.*—John Goodyear, South Middleton, Penn. 2
397. *Propelling boats, &c.*—Gideon Hotchkins, Broom county, N. Y. 2
398. *Cooking stove.*—Charles Higgins, Turner, Maine, 2
399. *Saw mill.*—Thomas B. Naylor, Jonesville, N. C. 2
400. *Tunnelling rivers.*—J. B. Bucklin and J. Jacobs, West Troy, N. Y. 11
401. *Metallic coffins.*—Jonas A. Grant, Richmond, Va. 11
402. *Cars, taking over elevations.*—Smith Cram, N. Y. 11
403. *Weaving, improvement in.*—Cullen Whipple, Douglass, Mass. 11
404. *Washing machine.*—Amory Davidson, Littleton, Mass. 11
405. *Boots, tucking machine.*—S. C. Blodgett, Rowley, Mass. 11
406. *Hubs for wheels.*—Jonathan Atherton, Philadelphia, 11
407. *Setting bones, apparatus.*—James H. Willard, Brownhelm, Ohio, 11
408. *Columns for building.*—Jordan L. Mott, N. Y. 11
409. *Iron and steel, making.*—William P. Boyden, N. Y. 11
410. *Distances, measuring.*—Rufus Porter, Bellerica, Mass. 11
411. *Horse power.*—Rufus Porter, Bellerica, Mass. 11
412. *Churn dash.*—Samuel Jackson, Jay, Maine, 11
413. *Screw, packing machine.*—Stephen Terry, De Kalb, Georgia, 11
414. *Endless chain propeller.*—Lewis Chevier, Philadelphia, 11
415. *Hat bodies, stiffening.*—J. P. Kettell and J. Wright, Worcester county, Mass. 11
416. *Garden Hoe.*—Isaac W. Averille, Plymouth, Mich. 11
417. *Bedsteads.*—Christian Knisly, Meadville, Penn. 16
418. *Malleable iron cannon.*—Geo. W. Chapman, N. Y. 16
419. *Oven, heating by anthracite.*—F. C. Tredwell, Brooklin, N. Y. 16
420. *Stove, conical.*—Robert Robertson, Albany, N. Y. 16
421. *Washing machine.*—Amos Sarcum, Troy, N. Y. 16
422. *Clover seed hulling.*—Cyrus B. Baldwin, Fincastle, Va. 16
423. *Scythe.*—Ezra Barnett, Warner, N. H. 16
424. *Cotton planting machine.*—Henry Allen, Fayetteville, Tenn. 16
425. *Churn.*—Amasa Wharff, New Gloucester, Maine, 16
426. *Plough.*—Joshua Gibbs, Canton, Ohio, 16
427. *Mortising machine.*—J. C. Channell, Dunstable, N. H. 16
428. *Planing machine.*—Lorrain Curtis, Sherburne, N. Y. 16
429. *Smut mill.*—John T. Towne, Mount Morris, N. Y. 16
430. *Stove, or air warmer.*—John J. Heintzelman, Philadelphia, 16
431. *Leather, shaving.*—Herkimer Johnston, Brooklin, Conn. 16
432. *Cooking stove.*—Will. A. Arnold, Northampton, Mass. 16
433. *Rice, &c. hulling.*—Lewis Cole, New Gloucester, Maine, 16
434. *Fire proof chest.*—James Matthews, N. Y. 16
435. *Mortising timber.*—Samuel E. Babcock, Alstead, N. H. 16
436. *Combing wool.*—S. and S. Couillard's assignees, Boston, Mass. 16
437. *Combs of metal.*—Henry Duvall, N. Y. 20
438. *Lamp burner, light house.*—Isaac Dunham, Bristol, Maine, 20
439. *White lead, &c.*—Edward Clark, Saugerties, N. Y. 20
440. *Cutting and planing stone.*—A. Clark & C. H. Boynton, West Stockbridge, Mass. 20
441. *Winding silk.*—Adam Brooks, South Scituate, Mass. 20
442. *Winding gimp or cord.*—Adam Brooks, South Scituate, Mass. 20
443. *Thrashing machine.*—J. Bailey and J. Sprinkle, Rockingham, Va. 20
444. *Horse power.*—William Whitman, Haverhill, N. H. 20
445. *Truss.*—John W. Newson, N. Y. 20
446. *Window fastenings.*—Marcus Merriman, jr., New Haven, Conn. 20
447. *Mortising machine.*—John Hawkins, Stockbridge, Mass. 20
448. *Stone cutting machine.*—J. and J. Sutton, Reading, N. Y. 20
449. *Rack wrench.*—Alonzo G. Hall, Troy, N. Y. 20
450. *Saddle, elastic.*—William McCormick, Bath county, Kentucky, 20
451. *Revolving lancet.*—T. C. Harrison, New Egypt, N. J. 20
452. *Clover seed, cleaning.*—Hildreth Robbins, Kennebec, Maine, 20

(TO BE CONTINUED.)

CELESTIAL PHENOMENA, FOR OCTOBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.					
17	.6	57	Im	Capricorni	,6,	N.132°	V.136°
17	8	10	Em			271	290
30	15	40	Im	ω' Cancri	,6,	24	5
30	16	57	Em			315	311

Meteorological Observations for June, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	44°	54°	29.80	29.80	E.	Brisk.	.60	Cloudy—showers, rain in night
	2	54	61	29.76	29 76	E.	do.	.16	Drizzle—cloudy—rain.
	3	55	60	29.76	29.80	E.	Moderate.	1.00	Drizzle—cloudy—rain in night.
	4	56	64	29.80	29.80	E.	do.		Rain—Cloudy,
☽	5	58	67	29.85	29.90	E.	do.		Drizzle—cloudy.
	6	57	67	29.90	29.90	E.NE.	do.	.45	Cloudy—rain.
	7	60	74	29 94	29.94	NE.	do.	.07	Fog—flying clouds, rain.
	8	64	74	29.90	29.96	E. SE.	do.		Fog—flying clouds.
	9	64	86	29.97	29 97	SW W.	do.		Fog—clear.
	10	62	78	29.98	30 05	N.NE.	do.		Clear day.
	11	60	83	29.95	29.80	ES.	do.	.22	Fog—flying clouds, rain.
	12	64	79	29 83	29.80	W.	do.		Clear—flying clouds.
	13	58	74	30.00	30.05	E.SE.	do.		Floating clouds—clear.
⊗	14	58	75	30.00	29.95	NE.N.	do.		Cloudy—clear.
	15	59	76	29 93	29.93	NW.	do.		Clear day.
	16	54	80	30.05	30.05	NW. W.	do.		Floating clouds, clear.
	17	66	86	29.90	29.90	W.	Brisk.		Clear day.
	18	68	89	29.85	29.85	W.	do.	.25	Hazy—clear, thunder shower,
	19	68	86	29.80	29.75	N. E.	Gale.	.70	Clear day—thunder shower,
	20	70	64	29 70	29.70	N.	Moderate.	1.30	Cloudy—rain, thunder & lightning
	21	54	60	29.70	29.70	E.SE.	do.		Drizzle—cloudy.
☾	22	55	66	29.83	29.85	S. E.	do.		Cloudy—cloudy.
	23	56	61	29 90	29.90	E.	do.		Cloudy—rain.
	24	54	59	29.90	29.84	E.	do.		Cloudy—cloudy.
	25	54	62	29.84	29.84	E.	do.		Drizzle—cloudy.
	26	54	58	29.84	29.85	E.	do.	1.40	Rain—rain in night.
	27	54	64	29.90	29.85	NW. W.	do.	.41	Cloudy,
	28	56	78	29.85	29.85	E.	do.		Clear—lightly cloudy.
☺	29	62	80	29 80	29.80	W.	do.		Lightly cloudy—clear.
	30	61	80	29.85	29.85	W.	do.		Clear day.
	Mean	58.63	71.50	29.87	29.87			6.56	

	Thermometer.	Barometer.
Maximum height during the month.	89. on 18th.	30.05 on 10th, 13th. 16th.
Minimum do.	44. on 1st.	29.70 on 20th, & 21st.
Mean do.	65.07	29.87

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

OCTOBER, 1836.

Practical and Theoretical Mechanics.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II.,* *containing the* GENERAL REPORT *of the Committee.*†

The Committee appointed "to examine into the causes of the explosions of the boilers used on board of steamboats, and to devise the most effectual means of preventing the accidents, or of diminishing the extent of their injurious effects," respectfully submit to the Board of Managers of the Franklin Institute, the following report:

The Committee undertook the task imposed upon them by the Franklin Institute, with a deep sense of the responsibility which it involved. On the one hand, a series of disasters by which human life was sacrificed, called loudly for an investigation of the causes which produced them; on the other, an untimely or ill-directed interference with a branch of industry, which has been a source of unparalleled advantage to our country, was truly to be deprecated.

Emanating from an Institute "for the promotion of the Mechanic

* For Part I. See Vol. XVII.

Arts," the Committee felt advantageously situated. They could not justly be suspected of a desire to trammel the progress of any art; and yet the public confidence, which had always been accorded to the institution, would naturally attach to a Committee selected by it.

The Committee further believed that the apprehensions of the public, aroused by the frequent recurrence of accident, could only be satisfactorily allayed by an investigation, which would show that such accidents were not unavoidably incident to the useful agent which they distrusted, but resulted from a want of due regulation of its power, or from circumstances incidental to its use which could be foreseen, and therefore guarded against. If disappointed in this anticipated result of investigation, the Committee hoped to satisfy those who are public carriers, that it was their duty to provide protection for those who trust life in their hands, against an agent thus found to be uncontrollable.

With these views the Committee commenced, actively, the collection of information upon the subject intrusted to them. The replies to their circular were canvassed in their meetings, and finally laid before the public.* It occurred most opportunely for the ultimate success, though not for the rapid completion of their labours, that an opportunity was afforded them for experiment, by which to test many of the suggested causes of, and preventives to, the explosions of steam boilers.

These experiments, originally proposed by our public spirited fellow-citizen, S. D. Ingham, Esq., then Secretary of the Treasury of the United States, have been brought to completion and presented to the public under the auspices of the present Secretary.†

The Committee trust that they have, by the experiments just referred to, shown not only what are some of the causes of explosion, but, which is quite as important, what are certainly not causes. In this way they hope to have turned away the attention of ingenious men from false hypotheses which cannot furnish the remedies they are in quest of, and to have pointed out some directions in which their labours may be profitably bestowed.

A desire to complete the reports upon their experiments, has induced a delay in the present report, which, thus far, however, the Committee are satisfied will be found to have been judicious. This conclusion they rest upon the many references, which will appear in the following pages, to those experiments, which have given an authority to recommendations and suggestions, that could not have been claimed for them unless thus strongly supported by facts.

They regret much that the part of their report referring to the strength of materials will, from circumstances, be unavoidably incomplete. This deficiency, they hope, will hereafter be made up, the experiments on the subject having been some time since concluded; and they do not feel warranted, by this cause, in any longer delaying their general report.

* As these replies will be frequently referred to in what follows, it is proper to state here, that the references are made to the pamphlet distributed by the Committee to their correspondents and others, and that Nos. I. to XIII., both inclusive, were published in the "Journal of the Franklin Institute of Pennsylvania for the promotion of Mechanic Arts," Vol. VIII.; Nos. XIV. to XXVIII., both inclusive, in the same Journal, Vol. IX.; No. XXVIII., part second, and XXIX., in Vol. X.; and No. XXX. in Vol. XI.

† Hon. Levi Woodbury, for whose promptness in forwarding their views, the Committee beg leave here to return thanks.

In this report the Committee have endeavoured, by examining the different accounts of explosions on record, and the writings on collateral subjects, to ascertain what causes have been operative in producing these disasters. The difficulty of procuring satisfactory testimony in regard to them, has been often pointed out. Most frequently those from whose mismanagement or want of vigilance they have immediately resulted, have been victims to them, and when they have survived, the precise state of things before the occurrence was imperfectly known to them; and, however honest, their minds have received a bias towards the non-existence of certain circumstances judged likely to have produced the results.

It hence follows that in regard to many explosions, either none of the circumstances which immediately preceded them, and bearing upon them, are known, or by inaccurate statements of them, an appearance of mystery is thrown around the whole matter, calculated to baffle research, and to alarm the community, who are exposed to a recurrence of the same dangers. Thus it happens that of the numerous explosions on record, few are made to subserve the cause of humanity, by a knowledge of their proximate causes. The details of the number of killed and wounded, and of the more or less entire destruction of the boilers and of the boats, are given in the daily prints, and public curiosity is satisfied.

In making their examination, then, of the cases of explosion, the Committee have selected such as they have found most directly to the points in support of which they are cited; omitting others in which the facts are less clearly made out, or in which the causes assigned may be resolved into matters of opinion. Having themselves no theory, or theories, to support, they have of course not been biassed, by such views, in the selections made.

This mode of proceeding is, obviously, not calculated, by one effort, to exhaust a subject. But the Committee believe, that they are able to make a decided step forward in the knowledge at present existing, in a connected form, on this subject. That to the causes pointed out by a Committee of the British House of Commons,* in 1817, namely, improper construction or material of a boiler and undue but gradual increase of pressure, they will be able to add others as important, and as fully proved as the former. Nor will any cause for alarm result from this extension, since it will be found that it is only ignorance of these circumstances which constitutes their danger, and that they may be prevented from occurring and remedied when they occur. It will be full time after the well-ascertained causes of explosion have been duly guarded against, to look for others more occult in their nature, if indeed there are such.

In the following report, the Committee propose to examine separately the circumstances which they consider as the proximate causes of explosions in steam boilers, and the preventives or remedies which have been proposed to meet them. Under each division of the subject they will make the suggestions or recommendations to constructors and others, which they base upon the previous discussion; and at the close of the Report, will present a project of a law for carrying into effect, in regard to steamboat boilers, those recommendations which are of primary importance.

It will be observed thus, that while they do their duty to the arts by pointing out as far as their knowledge extends what they consider improve-

* Charles Harvey, Esq., Chairman.

ments or valuable alterations, they do not propose to render imperative any measures but such as are required for public safety.*

In submitting this project the Committee obviously do not entertain a doubt of the competency of Congress to legislate on the matters embraced in it. The several discussions in that body on the subject,† the recommendation of the President of the United States,‡ and especially the very detailed provisions of the bill recently proposed in the Senate, fully sustain them in this opinion. They consider the question now to be, not whether any regulations may be made, but how those to be made may be rendered most efficient and complete. For this completeness the very respectable Committee§ who reported the bill referred to, in the Senate of the United States, have expressed themselves anxious; and the labours of this Committee, so far from being an interference, will, no doubt, as far as they may be approved, be looked upon as forwarding the views thus expressed.

The good effects which have attended the adoption of partial preventives in England, and the excellent effects from the more complete ones in France, should urge us, as Americans, to do our part in preventing further destruction of life and property by these disastrous explosions. And while we apply means for this purpose, experience and reason both teach us that they will produce no undue or severe restraints upon mechanical skill or commercial enterprise, but rather that they will aid both, by increased confidence on the part of the public.‖

The Committee propose to investigate the different causes of the explosions in steam-boilers under the following general divisions.

I. Explosions from undue pressure within a boiler, the pressure being gradually increased.

II. Explosions produced by the presence of unduly heated metal within a steam-boiler.

III. Explosions arising from defects in the construction of a boiler or its appendages.

IV. Explosions resulting from the carelessness or ignorance of those intrusted with the management of the steam-engine.

V. An examination of the particular cases of collapse of a boiler, or its flues, by rarefaction within.

I. Explosion from undue pressure within a boiler, the pressure being more or less gradually increased.

1. This is one of the most natural causes to look to as producing the bursting of steam-boilers, and one which, probably, is as frequently operative as any other. It might be supposed that with a safety valve always applied and a mercury gauge so easily applicable, the low pressure boiler should have been exempted from explosion. But such has never been the

* This project is put forth with a view to free discussion, without which the Committee would feel entirely unwilling that it should be adopted. They propose, with this view, to distribute it as widely as possible, and invite especially a discussion of its provisions, in the Journal of the Franklin Institute.

† See Act regulating steam vessels, proposed in 1824, mainly founded on the action of the Committee of Councils of Philadelphia; and especially the report of Mr. Wickliffe, from a Select Committee of the House of Representatives, May 1832. [Pub. Doc. Rep No. 478.]

‡ In the annual message for 1833.

§ The Committee on Naval Affairs: Hon. Samuel L. Southard, Chairman.

‖ Professor Silliman, in an article on the safety of steamboats, has the following strong expression of opinion: "The boat which is first ascertained to afford absolute security will be a fortune to its proprietors."—Silliman's Journal, vol. XIX. p. 146.

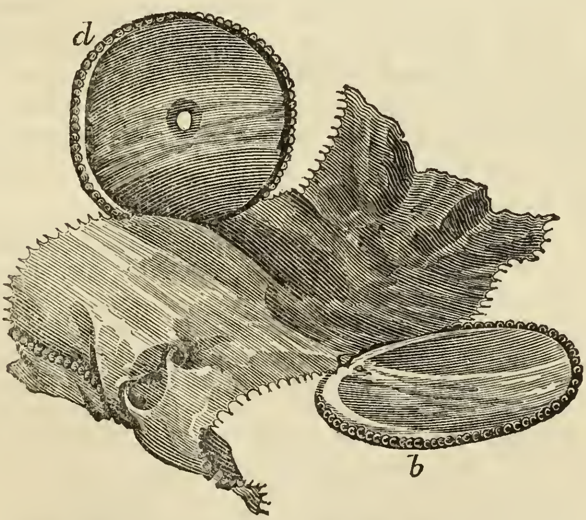
case, and we find a select Committee of the British House of Commons, in 1817, specially directing their inquiries to the cause above stated, as producing the disastrous explosions which, even at that day, called for legislative interference.

2. That a gradual increase of pressure can produce all the effects of the most violent explosions, may be inferred from many cases on record, attributed with probability to this cause; and was proved conclusively by the direct experiments of this Committee. In these latter, cylinders of copper and iron were violently torn asunder, the parts thrown from their places, scattering the materials of the temporary furnaces over which they had been heated, and of the fire, to considerable distances.* There are also cases well made out in which a weak place in a boiler has acted as a safety valve, but such fortunate circumstances are not always to be looked for, and better methods have been devised of effecting the same object, than to imitate them by the use of thin plates. The idea stated to be current,† namely, that a boiler does not explode if duly supplied with water, is wholly untenable and highly mischievous in its tendency.

* This effect is well illustrated by the rendering of a copper cylinder just referred to. The subjoined figure and extract are from the first part of the report of the Committee on Explosions, &c. p. 68. (Jour. Franklin Institute, vol. xvii. pp. 224, 225.)

"As before, nothing remarkable occurred previous to the instant of explosion, and the members of the committee, employed in the experiments, were engaged in observing the boiler at the instant it exploded. A dense cloud of smoke and flame, capped by steam, rose from the pit; the stones and combustibles were widely scattered, and the boiler was thrown, in a single mass, about fifteen feet from the furnace. The noise attending this explosion was like that from the firing of an eight inch mortar.

"The boiler was rent as shown in the accompanying figure, giving way in an irregular line, just above the probable water line on one side of the boiler, but not conforming to it. *d* and *b* were the lowest points in the two heads before the explosion. The



sheet of copper was torn from the heads, unrolled and irregularly bent, adhering to the heads for only a short distance near the top of each; and the heads were bent outwards. The thickness of the copper along the line of rupture varies from 0.25 to 0.35 of an inch, and the metal appears to have been highly heated at one end of the torn portion."

† Replies to Circular of Com. on Explosions, &c. No. XII. Report of Thos. Bakewell, Esq.—"at a subsequent period and after the captain had conversed with some of those who contend that a boiler cannot burst with 'fair play,' as it is termed."—To meet this prejudice, the Committee have chiefly selected their proofs from accidents which have occurred abroad.

19*

3. We are warranted, then, in looking to the failure of the apparatus designed to prevent undue pressure, or to the misuse of it, as the cause of explosions of the most violent kind. The current of testimony is too strong to permit the former view to the exclusion of the latter. It has been too clearly shown that those who have charge of the steam engine sometimes not only neglect the means of safety provided, but actually render them inoperative. Not to multiply instances, the Committee refer to the following as entirely well made out, and in which the connexion between the misuse of the means of safety and the explosion is fairly to be inferred. First; That of a cast-iron boiler used in a sugar-house in Well-close-square,* London, the mercury gauge attached to which was plugged up and the safety-valve purposely overloaded at the time of explosion. Second; The case of a steam tow-boat on the Rhone,† in France, when the safety-valves of the four boilers were fastened down, so as to be immoveable. Third; The explosion of one of Trevithick's locomotives,‡ when the safety-valve was kept down to raise steam at starting. Fourth; The explosion in the steam carriage of Messrs. Burstall and Hill,§ when in going over a soft piece of road, in which the coach laboured, the engineer kept down the safety-valve, by pressing upon the lever. And Fifth; The explosion of the boiler of the steamboat New England from a "pressure of steam, produced in the ordinary way, but accumulated to a degree of tension which the boilers were unable to sustain."||

4. If the apparatus devised for the low pressure boiler has been rendered inoperative, the high-pressure boiler has had to contend with peculiar difficulties. No gauge applicable to it has yet been brought into use. The open gauge must be of undue height, or cumbrous in its serpentine form; and the closed gauge requires great nicety in construction, and a correction for the temperature of the air enclosed in it. A graduated safty-valve would give the engineer desirable information, and has been to a certain extent used. The engineer of a locomotive engine, where the spring weighing machines are used with the safety-valves, has it in his power to ascertain at any moment, the pressure within the boiler.

He has it is true besides, the power of keeping the valve down even when the pressure within may be unsafe, but then he and his assistants would probably be the only victims of its abuse.

* Minutes of evidence before a Select Committee of the House of Commons, &c. &c. by Geo. Dodd, Civ. Eng. Evidence of Mr. Braithwaite, Mr. Richter, &c. Also, Partington on the Steam Engine.

† Annuaire du Bureau des Long., 1830, p. 141. Jour. Frank. Inst. vol. v. p. 401. It is stated in the London Jour. of Arts, that the pistons of the engine had become fixed in the cylinders by being expanded more rapidly than these latter, and that Mr. Steele, the manufacturer of the engine, supposed the steam to be insufficient, and was induced by the desire to have his engine succeed, to adopt a device which resulted so fatally. London Jour. Arts, vol. xiii. p. 346.

‡ Minutes of Evidence, &c. Evidence of Mr. Chapman.

§ Reply to Circular of Com. on Explosions by L. Hebert, Esq. of London, No. II. See also the bursting of one of Hancock's boilers, from the fastening down of a safety-valve. Lond. Mech. Mag. vol. xviii., and Jour. Frank. Inst. vol. xi. p. 277.

|| The part marked with inverted commas is the conclusion drawn by an able committee who investigated the cause of this explosion. It is unpleasant to see in this case, how those concerned in the press of steam, were biassed in their views given to the committee and communicated, as the committee testify, as honest convictions, and without intention to deceive. The engine men were not injured by the explosion. The form of these boilers was no doubt defective, and one part of them will be commented on hereafter. The two boilers exploded almost simultaneously.—Jour. Frank. Inst., vol. xiii. pp. 55 and 126.

5. The extraordinary and fatal increase of pressure which the Committee have above shown to be produced designedly at times, has at others been attributed to the adhesion of the safety-valve. A practical engineer, Mr. John B. Calhoun, has given a remarkable instance of this kind* as occurring to a safety-valve on the boiler of the steamboat Legislator, then navigating the Hudson. The mercury-guage indicating an undue pressure within the boiler without the raising of the valve, the engineer endeavoured first to raise it by a cord which passed into the fire-room: failing in this he went to the top of the boiler where the valve was, and moved the weight upon it towards the fulcrum, but without effect. He then applied his force at the end of the lever to raise it, when suddenly the valve opened with a loud report, and the flow of steam commencing lasted some time before the elasticity had diminished to its usual degree.

6. In this case, there can be but little doubt that the valve had corroded upon its seat or was fastened by the drying of oil, or other matter, to it. The carelessness of the fire-man who had charge of the boiler, and whose duty it was probably to raise the valve from time to time, is fully proved by his allowing the steam to get so high, that the rod of the mercury-gauge was against the boiler-deck, without giving notice to the engineer. Had not the latter observed, from the rapid working of the engine, that the steam was high, and investigated the matter, the lives of many would, no doubt, have been sacrificed.

7. The experiments made by M. Clement Desormes† on the tendency of disks, when placed in front of an aperture, through which air is forcibly issuing, to approach it, led him to condemn the safety-valve entirely, and especially the disk form. This sentence does not seem to the Committee to be just,‡ since the tendency upward, under the most favourable circumstances to its action, is very limited in amount, and may easily be counteracted by a device, which will lessen the acting weight, when a safety-valve is raised. Besides, the proportion which the area of the disk bears to that of the aperture materially affects the amount of this tendency, and is, in practice, very much less than was used in the experiments of M. Clement. The ingenious experiments of M. Hachette and Messrs. Hopkins and Roberts of Manchester, have shown the truth of these remarks.§ If

* Account of an extraordinary adhesion of the safety-valve of the boiler on board the steamboat Legislator, on the Hudson. By the Engineer. Jour. Frank. Inst., vol. v. p. 355.

† Notice in Franklin Journal vol. iv. p. 97. See also explanations of the phenomenon offered by Jacob Perkins, Esq. in the same volume, p. 252, and in London Jour. Arts, vol. xiii. p. 275. By Doct. Hare in Jour. Frank. Inst. vol. ii. p. 58. By James P. Espy, Esq. in the same vol. p. 59, and by Asa Spencer, Esq. in the same vol. p. 61. also remarks on p. 203.

‡ In this view the Committee coincide entirely with M. Arago. See Annuaire du Bureau des Long. 1830, p. 157, and Jour. Frank. Inst. vol. v. p. 408. In fact the committee named in the next note did not sustain the deduction, above referred to in the text, remarking, in very guarded terms, that the limits within which the phenomenon occurs were then not sufficiently known, to decide upon the possibility of an accident from it.

§ M. Hachette who investigated this subject shows in a strong point of view the effect of the relative proportions of the disks. When one is not many times the other in size it is impossible to satisfy the conditions of the problem. Annales de Chim. et de Phys. vol. xxxv. p. 44, &c. The Committee who examined this subject in its relation to the Steam Engine, consisting of MM. Biot, Poisson and Navier, made an experiment in which with a disk, nearly six times the diameter of the opening, and a pressure of steam about 2.8 atmospheres, the tendency to adhesion when the disk was .01 of an inch from the opening, was but half a pound. Annales de Chim. et de Phys. vol.

however, this action were allowed to have full effect, by dimensions in the valve expressly intended to produce it, an increased area of valve would entirely obviate the objection. Different effective means of lessening the acting weight, on the rise of a safety-valve have been used or proposed, such as that employed by MM. Arago and Dulong* in their experiments, on the elastic force of steam at different temperatures, or the very similar one, described by Mr. L. Hebert in his interesting communication to this Committee.† In them the weight rolls towards the fulcrum when the valve opens.‡ The Committee apprehend that this form, although very effective while in order, would tend by disuse to lose its power of action. They would prefer, in practice, a construction similar to the second form proposed by Mr. Hebert in which the lever being curved effects the same object, while the weight is not required to be moveable. They intend to recommend a suitable form of lever of this kind.

The practice of passing the stem of a safety-valve through a stuffing box, as it is calculated entirely to defeat the object of the valve, should never be allowed. In fact the more open to inspection all the parts of the apparatus are the better. If it is necessary to carry off the steam from that which the engine-man has the control of, it can be accomplised without resort to packing.

9. There can be no doubt that the form of the safety-valve materially influences the certainty of its action. Although the disk-valve was early recommended, the nicety of workmanship required to make it tight has limited its use, and perhaps the experiments of M. Clement have produced a prejudice against it. The cone, which is in common use, may be more easily tightened when perfectly fitting the seat; but this very fact is an objection to it. No pressure can cause the disk valve to prevent the escape of steam, if the valve and seat be clean, unless they have been ground to fit. The Committee adopted this form of valve in their experiments,§ and in no instance was undue adhesion observed. Throughout their experiments, the pressure of the steam corresponding to the opening of the valve with its different weights, was noted by the steam-gauge, or by the temperature of the water within the boiler. No means were used to keep the valve in other than what might be considered fair working order, but when, from the action of dirt, it had become leaky, the grinding upon the seat was very easily performed, and restored its efficiency. Two valves of the same form were used, and the comparison of the calculated pressures due to the weight upon the valve, with the observed pressures at which the valve rose entirely, or leaked so badly as to require additional weight, uniformly gave the former in excess. The average ratio in the experiments was 1 to 1.035, the former number representing the observed, and the latter the calculated, pressure.

xxxvi. p. 70. In the experiments of Messrs. Hopkins and Roberts, with an excess of pressure in the effluent air of .05 of an atmosphere, over atmospheric pressure; the total tendency to adhesion at its maximum, was but .005 of an atmosphere, with an opening of $2\frac{3}{8}$ inches, and a disk of six inches in diameter. With a disk of eight inches in diameter the total tendency was increased from 32 oz. avoirdupois, to 48 oz: and with disks $4\frac{1}{4}$ in. diameter and under, no such tendency was manifested, the aperture of efflux remaining the same. Manchester Trans. vol. v. N. S. and Jour. Frank. Inst. vol. x. p. 188.

* Annales de Chimie et de Phys. vol. xliii.

† See replies to circular of Com. on Explosions, No. XI.

‡ In that of MM. Arago and Dulong there was also an arm projecting on the opposite side of the fulcrum from that on which the weight keeping down the valve was placed; upon this a weight rolled from the fulcrum on opening the valve.

§ Report of Com. on Explosions, part I. pp. 71,&c. Jour. Frank. Inst. vol. xvii. p. 228.

10. These conclusions are sustained, in a general way, by the success which has attended the recommendations of the select committee of the British House of Commons. The law, based upon their investigations, requires that there should be two safety-valves upon every boiler, one of which is out of the control of the engineer,—and further provides a penalty for the overloading of either valve, by any person whatever.*

11. In addition to two safety-valves, the regulations for the safety of the steam engine in France, require two fusible plates or plugs, of suitable diameter, to be attached to every boiler. These plugs are intended to act by the heat of the inclosed steam, and to give way when it has reached a certain point. In the application of them which we are now considering, they are exposed to a pressure corresponding to the temperature, and in order to prevent them from giving way as they verge towards the fusing point, they are covered with wire, or with perforated disks or gratings of metal.

12. This mean of safety was made the subject of elaborate experiments by this Committee.† The result was, that when alloys of tin, lead, and bismuth, such as are used for fusible plates, are exposed to heat and pressure, parts of them soften at temperatures below that at which the entire plate would become liquid. Being exposed to pressure, these fluid parts are forced out,‡ leaving a less fusible mass. In one case described by the committee, this operation was carried so far before the plate gave way, that from a plate melting at 254° to 275° Fahr., was produced a mass fusible only at 312° to 345°. One part of the alloy which oozed out was found to melt at 223° and another at 233°.§ To this action a fusible plug

* The regulations relating to the safety-valves of steamboat boilers, are as follows:

That every such boiler shall be provided with two sufficient safety-valves, one of which should be inaccessible to the engine-man, and the other accessible to him and to the persons on board the packet.

That the inspector shall examine such safety-valves, and shall certify what is the pressure at which such safety-valves shall open, which pressure shall not exceed one-third of that by which the boiler has been proved, nor one-sixth of that which by calculation it shall be reckoned to sustain.

That a penalty shall be inflicted on any person placing additional weight on either of the safety-valves.

Of twenty-three witnesses, practical engineers and others, examined by the Parliamentary Committee, seventeen recommended explicitly the additional safety-valve, out of the control of the engine-man.

† Report of the Com. on Explosions, of the Franklin Institute, Part I. p. 23. "V. Inquiry in relation to plates of fusible alloys." Jour. Frank. Inst. vol. xvii. p. 74.

‡ This fact, but to a limited extent, seems to have been noticed by M. Gualtier de Claubry, who did not, however, follow out the suggestion. Receuil Industriel, 1829.

§ The entire series of conclusions from these experiments, which formed one of the most interesting branches of the Committee's investigations, are as follows:

"The conclusions deduced from the foregoing experiments, on metallic alloys, may be thus stated.

"1st. The impurities of common lead, tin, and bismuth, are usually not such as to affect materially the fusing points of their alloys.

"2d. When mixed in equivalent proportions, tin and lead formed alloys, not presenting the characters of distinct chemical compounds, in definite proportions. The alloys between the range of one equivalent of tin, to one of lead, and one equivalent of tin to six of lead, varied considerable in the interval between the temperature of commencing to lose fluidity, and that at which a thermometer, immersed in the solidifying metal became stationary. These different alloys produced nearly the same stationary temperature in a thermometer plunged into the solidifying metal.

"3d. Fusible metal plates covered by a perforated metallic disk, and placed upon a steam-boiler, show signs of a fluidity at the disk, before the steam has attained the

would be also exposed, and the committee are of opinion that no method of application in which the pressure acts upon these compounds, can be efficient in practice.

In the experiments referred to, the plates being thin, were generally burst by pressure; not, however, acting precisely as thin plates of copper or iron would have done, but being partially softened by heat.

13. While the Committee deem it very desirable that a convenient steam gauge applicable to high pressure boilers should be devised,* they consider that until this is done, a substitute should be furnished in a graduated safety-valve, marked with numbers expressing directly in pounds to the square inch the bursting† pressure of the steam, and within the control of the engine-man. This would act as a convenient, and, for practice, a sufficiently exact method of knowing what he ought always to be informed of, the bursting pressure in the ordinary working of the boiler. Besides this, however, there should be a lock-up valve, for the original weighting of which there should be a proper responsible agent, and which should be capable of being raised by the engine-man, but not of being kept down. With a valve of this kind of sufficient dimensions, of proper form, and duly weighed, the Committee believe that danger from gradually increasing pressure might be entirely avoided.

A thermometer suitably graduated and passing into the steam or water of the boiler, would prove under ordinary circumstances, a useful gauge, and may be conveniently applied as described in a subsequent part of this report.

14. With a view to meet the dangers which have been discussed in this section, the Committee would make the following recommendations, the means of carrying out the principal of which, by law, will be found suggested at the close of the report:—

temperature of fusion of the alloy of which the plate is composed. This fluid metal oozes through the perforations in the disk, and the plate thus looses much of its substance before finally giving vent to the steam.

"4th. The under parts of the plate are not kept from fusion by a protecting film of oxide there formed.

"5th. The thickness of the plate is not important, provided only that it is sufficiently strong to resist the pressure of the steam at temperatures below its point of fusion.

"6th. The temperature at which the plates are cast, and the rate of cooling of the cast metal, do not affect the temperature at which the plates give vent to steam.

"7th. The effect stated in conclusion third, is explained by the nature of the alloys used, which are formed of portions of different fluidities; the more fluid parts, are forced out by the pressure of the steam, leaving the less fusible. These latter, in general, are burst, not melted.

"8th. By pressure in a receptacle provided with small openings, this effect of separating the differently fluid portions of an alloy, may be imitated.

"9th. Fusible alloys, used to indicate the temperature of any part of a steam-boiler, should not be exposed to the pressure of the steam; at least not in such a way that the separation of the differently fusible constituents of the alloys may be effected."—Report of Com. on Expl. Part I. p. 34, and Jour. of Frank. Inst. vol. xvii. p. 84.

* The Committee regret that the hydrostatic safety-valve of Mr. Ewbank has not been brought into use. It would answer, by a slight modification, as a gauge, and no doubt can exist of its being applicable to the stationary engine. The oscillation of the liquid may interfere with its operation on board of steamboats, but to what extent the Committee are not prepared to say. See description and figures Jour. Frank. Inst., vol. ix. p. 64, and,vol. x, p. 2.

† This term is used to signify the excess of pressure of the steam within, over atmospheric pressure, in contradistinction to the *working* pressure, which is used to express the total elastic force of the steam.

First. That every boiler be provided with two safety-valves, each of which shall be competent to discharge the steam, made in the ordinary working of the engine. The first of these valves should be graduated by the maker of the engine, and have stamped upon the lever by which it is weighed, the bursting pressure at which it will open, by calculation, when the moveable weight is placed at the several notches. The pressure corresponding to the last notch to be equal to the bursting pressure, under which the engine is to work. The second valve to have a weight fixed immoveably upon it, the pressure of which upon the seat, together with that of the atmosphere upon the valve, is equal to the working pressure of the engine. This valve should be so arranged as to admit of raising, but not of placing additional weight upon it. To this end it should be inclosed. The rise allowed by the inclosure should rather exceed half the radius of the valve seat.

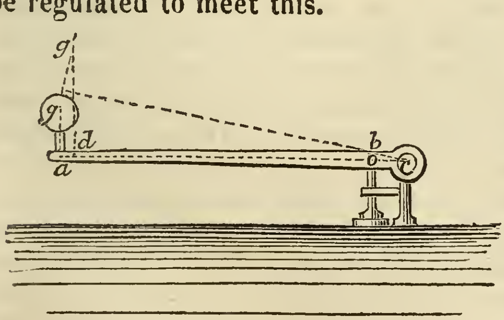
Second. The Committee recommend to constructors the disk valve. The diameter of the disk should not exceed once and a half that of the valve seat, as a less ratio than this will leave sufficient margin, and any sensible tendency to close from the effect of the issuing current will certainly be avoided.

Third. That a cord be attached to the lock-up valve, by which it may be raised at the same time with the free valve. And that the working of each be ascertained at least every two hours.

Fourth. That an open mercury-gauge be provided for each boiler of every engine not carrying more than two atmospheres of working pressure. The height of the mercury to be indicated by a float which shall truly mark upon a graduated scale the bursting pressure in inches.

For high-pressure boilers they recommend the thermometer, graduated to show the pressures corresponding to the temperatures of saturated steam, as a convenient gauge.

Fifth. That the lever of the lock-up valve be bent upwards at the end, so that in rising it shall relieve the valve of part of the weight. A suitable proportion for such relief would be about one-tenth of the pressure derived from the weight, and the height of the bend above the lever should be regulated to meet this.



The lever would have a form similar to the annexed. The part *a g*, which is turned up, may be straight or otherwise. The adjustment should be made so that *d c* is nearly nine-tenths of *a c*. *g* being the centre of gravity of the ball, lever, &c. will lie a little out of the centre of the weight, towards the fulcrum.

Sixth. As there can be no doubt that the competition in regard to speed is, or has been, a strong temptation to an undue increase of pressure by engineers or firemen, it should be expressly prohibited by law.

II. *Explosions produced by the presence of unduly heated metal within a steam-boiler.*

15. In a properly constructed steam-boiler no part of the metal is exposed to the direct action of the fire without being immediately in contact with water: the temperature of the metal cannot be raised above that of the water, and is thus determined by the weight upon the safety-valve.

When, from any cause, the metal is not so circumstanced, it becomes unduly heated, and danger may arise from two sources; first, the metal is weakened and rendered less capable of resisting even ordinary pressure; second, it serves as a reservoir of heat ready to bring into existence highly elastic steam, whenever water shall obtain access to it.

16. The first of these positions rests upon the basis of direct experiment, and is, the Committee believe, generally admitted.* Their experiments on the strength of materials have, however, developed a curious fact in regard to the strength of malleable iron, namely, that it slowly increases at first with an increase of temperature, and attains its maximum at a temperature above that at which any of the steam-engines used in practice, are worked. Above this maximum, the decrease of strength is very rapid; so as to be, at a red heat, but about one-sixth of that at ordinary temperatures. Copper, on the contrary, is weakened by any increase of temperature above the lowest, which was tried, namely, 32° Fah. The fact just stated in regard to iron, is interesting in its application to the proof of iron boilers, by the water-press, and as showing the great, and rapidly increasing, danger from diminished strength, as the metal is raised above the temperature of maximum strength.

17. Secondly the heated metal serves as a reservoir of heat to furnish highly elastic steam, when water is in any way brought into contact with it. That highly heated metal can produce steam, rapidly, has hitherto been a controverted position. In the experiments of Klaproth, successive drops of water thrown into an iron spoon, originally heated to redness, vaporized the more rapidly as the metal lost heat. In the experiments of Perkins and others, larger quantities of water in highly heated metallic vessels, vaporized very slowly. It is true that by injecting water into an iron cylinder, heated to redness, Mr. Perkins found a sudden increase of elasticity; but he attributed the effect to the hot and unsaturated steam which the cylinder contained, and through which the ejected water passed.† The Committee found that the temperature of clean iron at which it vaporized drops of water most rapidly, was 334° Fah.‡ The developement of a repulsive force is so rapid above this temperature that drops which required but one second to disappear, at the temperature of maximum vaporization, required 152 seconds when the metal was heated to 395°. One-eighth of an ounce of water introduced into an iron bowl, three-sixteenths of an inch thick, and supplied with heat by an oil bath, at the temperature of 546° Fah., was vaporized in fifteen seconds, while at the initial temperature of 507° Fah., that of most rapid vaporization under these circumstances, it disappeared in thirteen seconds. The cooling effect of the water upon the metal is here strikingly shown, by the increased temperature to which the latter has to be raised at the beginning of the experiment, in order to give the most rapid vaporization. A further illustration of the same kind is afforded by comparing the temperature giving most rapid vaporization, when the metal of the bowl is supplied with heat by a good and a bad conductor, or imperfect circulator, as by a bath of tin and one of

* In the minutes of the Select Committee of the House of Commons there is a statement by Mr. John Steel that cast-iron is strongest at the temperature of 300°, but it is not supported by reference to experiment.

† Franklin Journal, vol. iii. p. 418. Lond. Mechs. Mag. or Jour. Frank. Inst. vol. ix. p. 348.

‡ Report of Com. on Explosions. Part. I. Vaporization of drops." Reply to Query VI. Jour. Frank. Inst. vol. xvii. p. 90.

oil. With a rough surface, an iron bowl one-quarter of an inch thick, vaporized one-eighth of an ounce of water most rapidly by introducing it when the metal was at 555° Fah., the bowl being in an oil bath; while in a tin bath the corresponding temperature was 508° Fah.

18. By carrying out this idea we have the clue to the action of water thrown, in considerable quantities, upon heated metal; and find, accordingly, that when the water was increased sixteen times, or from one-eighth of an ounce to two ounces, the temperature of most rapid vaporization was raised from 460° to 600° Fah.; the surface of the metal being smooth, and the heat supplied through tin. Now, although differences in the mode of applying heat will alter these temperatures, it is clear that they rise rapidly with the quantity of water thrown upon the metal. In the case where as much water was thrown into an iron bowl as it could contain without loss by ebullition, the temperature of greatest vaporization, upon a clean surface, was 600° Fah. or about 200 degrees below a red heat, and would, according to analogy, have been higher if on a rough, or oxidated, surface.*

19. These observations explain the direct experiments made by the Committee, in which highly elastic steam was always rapidly produced by injecting water into a boiler heated to bright redness.† In one case, by the injection of ten ounces of water the elasticity of the steam was raised, in less than two minutes, to upwards of twelve atmospheres, and a miniature explosion produced. The remarks made in this experiment show, that wherever the water slid along the bottom of the boiler the spot of contact was for the instant blackened, by the sudden reduction of temperature, and this under the unfavorable circumstance of the introduction of a limited quantity. The bottom of the boiler in these experiments was clean, but not bright. The time required for the generation of explosive steam under these circumstances does not yet admit of calculation, but this may be affirmed with certainty, that a safety-valve which, under ordinary circumstances, may be adequate to carry off the excess of steam produced in a boiler, will prove wholly insufficient for its escape, in the supposed case.

20. These experiments are entirely supported by well authenticated cases of explosions in steamboat boilers. Mr. Bakewell‡ gives an instance in the case of the steamboat Grampus, where six cylindrical boilers, each thirty-eight inches in diameter, exploded simultaneously. The engineer had discovered that they contained very little water, and had suddenly thrown in a plentiful supply. When one of the boilers of the steamboat Car of Commerce§ exploded, it was well known that the pumps had not furnished the requisite supply of water; and just after an attempt to remedy this difficulty, the head of one of the boilers was thrown off. This boiler was, it seems, differently constructed from the others, with which it was connected, and which did not give way.

The first of these cases is distinctly made out, and the second cannot be resolved into a matter of opinion, as may perhaps be done with other acci-

* Report of Com. on Expl. &c. Reply to Query IV. "Vaporization of increased quantities of water." Jour. Frank. Inst. vol. xvii. p. 160.

† Ibid. Reply to Query II.

‡ Letter to Sec'y. of Treasury, communicated to Com. on Expl. Reply to Circular of Com. No. XII. Also, Letter of Thos. J. Haldermann, No. XXI. of Replies.

§ Letter of Thos. J. Haldermann, No. XXI. of Replies to Circular, &c.

dents, which, though there is a strong probability that they are to be traced to this cause, the Committee refrain from quoting.

21. It is, of course, not assumed that an explosion must necessarily follow the presence of heated metal; for other circumstances must conspire to produce such a result. Facts indeed, may be brought to show that, in certain cases, these attendant circumstances have been accidentally wanting, or have been judiciously avoided.

As examples of this, may be taken instances mentioned by Col. Long* in which timber on the top of cylindrical boilers has been known to take fire, though considerably remote from any fire-flue. Those to which Mr. Bakewell† has been an eye witness, when the steam has been so highly heated after leaving the boiler, as still to burn the hempen packing of the steam cylinder, and where wood contiguous to the boiler has been fired. Similar incidents not followed by explosions have occurred in the mines of Cornwall,‡ and in one of the Liverpool and Dublin packets.§ Examples of the second kind will be referred to subsequently.

22. With such a powerful agent present, as the highly elastic steam which it has been proved may be rapidly generated by the heated metal, it might have been supposed that no other cause for explosion would have been looked for, than the action of this steam. The case is, however, otherwise, and the Committee must turn aside from their direct course to examine briefly the theory which assigns the production, and subsequent destruction of hydrogen gas, as the cause of the explosion. According to this view, the water thrown upon the metal is decomposed, and hydrogen gas evolved; or a similar decomposition of the steam, by the hot metal, takes place. This hydrogen, becoming mixed with oxygen, is ignited by the red hot metal, and an explosion ensues. The difficulty of furnishing oxygen for the hydrogen to combine with, has lately been met more satisfactorily by Mr. Perkins, than it had been by any preceding theorists. He asserts that air is frequently drawn in by the operation of the forcing pump, and is thus accumulated in the boiler. The primary hypothesis, in regard to the production of hydrogen, having been fully disproved by the experiments of this Committee, there is no necessity for examining the minor ones; it may be well, however, to observe, that if air were introduced into a highly heated boiler, containing hydrogen in too large a quantity either to combine explosively, or silently, with the oxygen of the air, that element would be taken up by the heated metal; and that gases cannot enter, and remain without mixing with the steam, and being carried out with it. In the experiments of the Committee which have been referred to,‖ water was thrown upon the bottom of a boiler, heated to orange redness, without being decomposed. In fact the scale of oxide existing upon the bottom prevented the decomposition of water, by enfeebling the affinity which would

* Replies to Circular, &c. No. II.

† Replies, &c. No. XII.

‡ Mr. Perkins states on the authority of Mr. Moyle, that a ladder accidentally resting upon the top of a boiler, was set on fire by heat communicated from thence. Franklin Jour., vol. iii., p. 417, or Lond. Jour. Arts, vol. xiii., p. 95.

§ Evidence, before Com. of House of Commons, 1817. Hazard on Explosions. Frank. Jour. vol. iii. Ewbank on Explosions. Jour. Frank. Inst. vol. x.

‖ The reader should refer to these, that he may see the care which was taken in them. A negative result requires so much more caution than a positive one, that more time was devoted to those experiments in order to make them satisfactory, than the Committee deemed warranted by the importance of the subject. Report of Com. on Explosions, Part I. p. 61, &c. Jour. Frank. Inst. vol. xvii. p. 217.

produce it. This boiler was carefully cleaned, and in good working condition; a condition in which no one need be told, a boiler has not a bright metallic surface.

23. Carburetted hydrogen does no doubt exist at times in a boiler, in greater or less quantities, from the decomposition of oil, or of vegetable substances introduced to stop leaks, or to prevent deposites, but nothing warrants the idea that it can accumulate and mix with air, so as to be dangerous.

In furnaces where coal is used as a fuel, it will be seen in the sequel that gas, if prevented from escaping by the closing of a damper, may collect, and may possibly be a source of danger.* The ignition of a mixture of coal gas and air in a furnace has been known to destroy it,† as also of a mixture of gas from resinous wood and air; but these are cases altogether foreign from the subject under discussion.‡

24. The explosion of the steamboat Enterprise, on the Savannah river, is said to have occurred at the instant the boat was struck by lightning. This has been advanced as confirming the hydrogen hypothesis; but no inference can fairly be drawn from an accident, in regard to which the circumstances are so little known. If there was hydrogen present, there must have been unduly heated metal, and the direct action of electricity on the nonconductors around the boiler, may have so displaced it as to bring water upon the heated metal, and thus to effect an explosion. This, like the other supposition, is mere hypothesis. It is certainly, however, quite as contrary to analogy, that an electric spark should pass through any part of a space, like the interior of a boiler surrounded by a conductor, and thus explode a mixture of hydrogen and oxygen within it, as that it should shatter this extensive conductor by its direct action. The Committee consider the circumstances of this case as too illy defined to draw any inference from it, certainly not one which is contrary to sound theory, by which they mean general induction from numerous well observed facts.

25. Another case has been urged with much more appearance of directness in the testimony. A boiler in the Union rolling mills at Pittsburgh burst with a tremendous explosion; a cylinder with one of the heads attached, was thrown out of the works, and rising to a considerable height in the air, fell nearly two hundred yards from its former bed. A passenger in a boat which was near at the time, describes a stream of fire, as issuing from behind the boiler, which, according to the hypothesis under discussion, was a stream of burning hydrogen. It is almost needless to remark that if hydrogen had been the cause of the explosion it would not have burned in a stream behind the empty boiler as it rose; the observation is, however, perfectly well explained by Doct. Jones,§ by the stream of light which appears to attend every luminous substance moving rapidly, on account of the duration

* Explosion in the Gold mines as given by John Taylor, Esq. Philos. Mag. vol. i.

† M. Arago states this to be the fact on the authority of M. Gay Lussac. A furnace was thus destroyed at the Paris arsenal. Annuaire du Bureau des Long. 1830, p. 197, and Jour. Frank. Inst. vol. vi. p. 54.

‡ See the case of an explosion of a sheet-iron drum attached to an anthracite stove, with its explanation by Prof. Hare. Jour. Frank. Inst. vol. vi. p. 337. Pine shavings were used to kindle the fire, the gas from which, mixing with the air in the pipes and drum, produced an explosion, when the flame from the kindled shavings rose into it. Refer also to the explosion of the bellows of a smith's forge. Silliman's Jour. vol. xxiv. p. 192.

§ Jour. Frank. Inst. vol. iii. pp. 70, 71, "Editor on explosions in Steam Boilers."

of the impression upon the eye. That the boiler was red hot, there appears no doubt.

26. From this digression the Committee return to the pursuit of their subject. They conceive that it has been fully established, that the presence of unduly heated metal is dangerous, both from the weakness of the material, and the possibility of its producing highly elastic steam. They, therefore, proceed to examine the probable causes leading to this result, and which have been suggested either in the communications made to them or in other documents, and the proposed remedies for, or precautions against, the danger.

[TO BE CONTINUED.]

On the metallurgic treatment of the Galena of Bleyberg in Carinthia. From the French of M. BOULANGER, *Candidate, Engineer of Mines.**

A very simple and commodious method of treating galena, is pursued at Bleyberg, in Carinthia, the theory of which process forms an interesting subject of enquiry, and it was this which induced me to make the following analysis of the products of the various operations pursued at these works. I shall first give a short description of the operations, extracted from the journal of a tour made in this country in 1832–'33, by MM. Gruner Harlé and Foy.

The mineral employed at Bleyberg is galena, found in veins in limestone, of which two kinds are chiefly worked; in one of the beds the galena is accompanied by pyrites and blende, with traces of silver; the other contains pyrites likewise, but rarely blende, and encloses sulphate of baryta and molybdate of lead without a trace of silver.

The two ores are dressed with much care, and mingled in such proportions as to be of good quality; for in order to be worked to advantage, they ought to yield 65 or 70 per cent. in a small assay. When prepared for smelting, they contain a little pyrites, blende, sulphate of baryta and limestone.

The operations are conducted in a reverberatory furnace, eleven feet long and four and a half broad, (figs. 1, 2, 3,) parallel to the longer side of which is the fire place. The bottom is inclined at an angle of 25°; the fire place, formed of brick arches, at about 36°. The flame and smoke escape through the chimney, situated at the side of the charging hole. The bottom is formed of clay, old bottoms and refuse pounded together in a dry state; it is slightly cylindric in its whole length, forming a kind of trough in which the lead flows.

When the bottom is well beaten, it is fired for five or six days, the heat being increased towards the last, to soften it, and it is then smoothed.

Each operation for the reduction of the galena consists of three parts; 1. roasting, 2. raking, 3. the operation termed *pressen*, in which the lead is acted upon by air and charcoal.

1. *Roasting*. The furnace is charged with three quintals, twenty lbs.† of the washed ore of two different sizes and qualities, the mean product of which should be at least 70 per cent. lead. When the foregoing

* Translated at the request of the Committee on Publications, from Ann. des Mines, 3rd Serie, T. VII., by J. C. Booth.

† The quintal is 221 lbs. avoirdupois, English, and the French lb. about 2lb. 3oz. TRANS.

operation is complete, the furnace is suffered to cool for a quarter of an hour, and then charged with the ore, which is spread uniformly by an iron *rake.* The heat is maintained at incipient redness to avoid the fusion of the sulphuret, and ought to be lower, in proportion to the purity of the material, because its tendency to fuse is diminished by the infusible nature of the matrix. It is stirred up every half hour by an iron rod, the handle of which rests on a hook suspended by a chain; not however, too frequently, for that would retard the roasting.

Fig. 3.

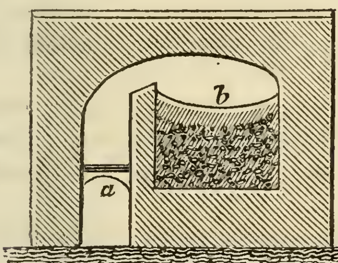


Fig. 2

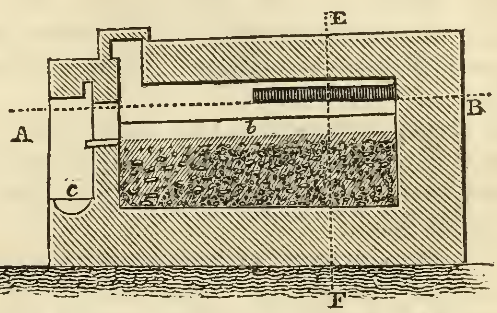


Fig. 1.

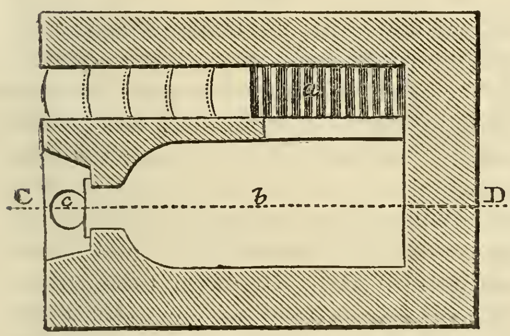


Fig. 1. is a horizontal projection along A, B, of *Fig.* 2. *Fig.* 2, a vertical section through C, D, of *Fig.* 1, and *Fig.* 3, a vertical section through E, F, of *Fig.* 2. *a*, represents a fire place arched with bricks, *b*, is the sole, and *c*, the basin to receive the lead.

This first operation lasts from four to five hours,* during which the temperature is gradually raised, and that without inconvenience, since the fusibility of the material diminishes in proportion to its oxidation; besides which an elevation of temperature causes a re-action, producing lead which often begins to flow out in a couple of hours. The heat ought not, however, to be carried so far, that the lead comes red from the furnace. This is called virgin lead, and is received into an iron vessel placed beneath the charging hole.

2. *Raking* or *Stirring.* While the roasting is going forward, the fire is increased to cause a more energetic re-action of the materials, causing the lead to flow abundantly. The workman frequently stirs the mineral by spreading it out, and again bringing it into a heap, and at length pushes it down to the bottom of the furnace, where the heat is more intense, at the same time surrounding the charging hole with blazing wood. This second part gives with the first, two-thirds of the lead, and when, notwithstanding the *stirring*, the lead ceases to run, the next operation follows.

3. The *Pressen* is only performed every second smelting, because it produces but little lead and requires much fuel, besides which the ore is diminished in bulk. When the second operation is completed, the refuse, called the rich scrapings (krätze), is taken out; fresh ore is added and treated like

* According to Villefosse, six to seven.—Trans.

the first; the first refuse is then added to the last, they are spread over the bottom of the furnace, and several shovels of live coals taken from the fire place, scattered over it. The workman mixes the whole by means of the iron rake, pushes it to the bottom of the furnace, increases the fire and stops the charging hole with blazing faggots. The lead flows out, and upon its ceasing, the workman again spreads out the pile for roasting, after which he adds more charcoal and brings the whole again into a heap. This alternate oxidation and reduction is continued till there are no longer traces of lead.

This operation lasts three hours, and when completed, the residue, termed the "poor scrapings," is taken out, and the bottom beaten to prepare it for another charge. The poor residues are stamped, washed and mingled with the ore.

One *poste*, composed of two charges, lasts twenty-one hours, during which one and the same workman performs all the labor, who afterwards rests for two *postes*. Each poste gives from four quintal, forty lb. to four quintal, sixty lb. of lead.

We now pass over to the examination of the products of these operations. The roasted ore taken out of the furnace before being stirred, is composed of a slightly caked, sandy mass, showing only a fusion of the lead, when subjected to a high heat in an earthen crucible. With black flux it gave 50 per cent. metallic lead, which gave no trace of silver by cupellation. This substance is very heterogeneous, presenting oxides, unchanged galena, and metallic lead, the greater part of which may be separated by stamping and sifting. The powder thus obtained, was boiled with water, which dissolved sulphuric acid, lime, and oxide of lead; the lime was present in larger quantity than was necessary for saturating the sulphuric acid, and to this excess was probably owing the solution of lead with sulphuric acid. But did sulphate of lime pre-exist in the mass, or was it not rather afterwards generated by the action of water? In order to ascertain this, I boiled water with a mixture of sulphate of lead and caustic lime, and found that all the acid was dissolved, together with a certain quantity of lead, which varied with the quantity of lime and water employed. The acid might, therefore, have existed in the state of sulphate of lead, and only combined with lime through the interposition of water; but since the sulphate of lime is more fixed than that of lead, the same might have occurred in the dry way, and the salt of lime have been formed in this case likewise; it is hence impossible to say in what state of combination the sulphuric acid existed.

Boiling acetic acid extracted from the remainder, insoluble in water, lime, oxide of lead, and protoxide of iron.

From this remainder, hydrochloric acid disengaged sulphuretted hydrogen. Having ascertained that silica was dissolved, which would be in a gelatinous state, I thought it advisable to extract this by means of liquid potassa, before the use of hydrochloric acid; the decomposition of the sulphurets might be apprehended by this means, and possibly a small portion of oxide of lead, found in solution in the potassa, arose from decomposed suphuret, for an excess of sulphur was found by analysis; but without doubt the greater part of the oxide pre-existed in the substance in the state of oxisulphuret, and could not be taken up by the acetic acid.

The residue insoluble in potassa was treated with hydrochloric acid, and the liberated sulphuretted hydrogen received into ammoniacal nitrate of copper; an analysis of the resulting sulphuret gave the quantity of sulphur

contained in the metallic sulphurets; the hydrochloric solution contained iron, zinc and lead.

The residue insoluble in the hydrochloric acid contained a little lead, which was taken up by weak nitric acid, and added to that obtained by sifting. Lastly, roasting the last residue gave a little sulphur from its loss of weight, and there remained only sulphate of baryta, as was ascertained by an analysis with carbonate of potassa in a silver crucible.

According to this analysis, the roasted ore is composed of

Oxide of lead,	0.310
Sulphuric acid,	0.023
Lime,	0.042
Oxide of iron,	0.004
Sulphuret of lead,	0.225
" iron,	0.022
" zinc,	0.069
Sulphur,	0.002
Silica,	0.016
Sulphate of baryta,	0.034
Metallic lead,	0.233
	0.980

It follows from this analysis, that the roasted ore is principally composed of metallic lead, its sulphuret and oxide, for even supposing all the sulphuric acid to be in the state of sulphate of lead, still there would be but 8 per cent. of it; now the roasting process, in heaps, generally gives a larger quantity of this sulphate; it is the more remarkable that the roasting in a reverberatory furnace gives rise to so small an amount, because it is performed in this case at a very low temperature, exposed to a current of air that ought to be highly oxidizing; in fact, the very inclined position of the fire place creates a current of air, which mingles with the flame above the fire, independently of the one below it; besides, in order to enter the furnace, the flame is obliged to pass through an opening only four inches in height, (an arrangement analagous to the smoke-consuming furnaces of M. Lefroy) necessarily causing an eddy and a consequent mixture of the air and combustible gases, which ought to deprive the latter of every deoxidizing property; notwithstanding these circumstances, so favourable to the production of a sulphate, but little is formed. It appears to me explicable in the following manner.

The first effect of the roasting is to produce oxide of lead, which tends to unite with the sulphuric acid generated; the production of this sulphate ought therefore to be in proportion to the quantity of free oxide; now in a reverberatory furnace, the oxidation takes place superficially, and the oxide is in contact with the unchanged sulphuret beneath it; a reaction occurs, with the consequent production of metallic lead, while very little oxide is formed; it is hence easy to perceive that too frequent raking would produce a large quantity of oxide, part of which would be converted into sulphate, because the reaction could no longer as easily occur; and we have seen, that at Bleyberg, the surface is renewed every half hour.*

In roasting in heaps, the ore is put in layers alternating with charcoal, where reaction would only take place between the substances in the same

* The theory may be stated thus: the basic sulphate of lead forms with the unchanged ore a pasty mass, a lower sulphuret than galena, from which the lead flows, by a conversion of a part into a higher sulphuret.—Trans.

layer, but as all are equally exposed to the oxidizing current, they are soon roasted in an equable manner, and the production of sulphate ought consequently to be considerable. In fact, by comparing the quantity of sulphate produced by roasting the same ore in heaps, or in a reverberatory furnace, we shall find these suppositions verified; at Holzapfel, for instance, roasting in heaps produces 19 per cent. of sulphate, in a reverberatory 8 per cent.; at Pezey, in the one case, 65 per cent. of sulphate is obtained, while the other operation produces none. Roasting in reverberating furnaces offers therefore, great advantages, since it generates the least possible amount of sulphate.

By exposing the roasted ore to a strong heat, a reaction is caused between the oxide and the sulphuret, with the production of a fresh quantity of lead, an operation termed stirring (Bleirühren).

The resulting "rich scrapings" have absolutely the same appearance as the roasted ore, containing, like it, metallic lead imbedded in the mass, and through the whole are perceptible brilliant scales of galena. Assayed with black flux, they give 51 per cent. metallic lead, which leaves, by cupellation, a button of unalloyed lead.

An analysis of this substance, made in the same manner, gave the following results:

Oxide of lead, - - - -	0.305
Sulphuric acid, - - - -	0.037
Lime, - - - - -	0.116
Oxide of iron, - - - -	0.012
" zinc, - - - -	0.038
Sulphuret of lead - - - -	0.061
" iron, - - -	0.029
" zinc, - - -	0.074
Silica, - - - -	0.028
Sulphate of baryta, - - - -	0.051
Metallic lead, - - - -	0.183
	0.934

An examination of the above analysis will show that this substance differs but little from the roasted ore, for it is nothing more than a product of roasting, except that the oxides are present in larger quantity from the nature and length of the process. By comparing the lime with the sulphate of baryta, it will be perceived that this base has nearly doubled. Can this be attributed to the want of homogeneousness of the substance, or may we not rather suppose, that a small quantity of lime has been added during the process, (which is sometimes done,) either to saturate the sulphuric acid, produced in abundance by continued roasting, or to diminish the fusibility of the substance exposed to a more elevated temperature during the stirring process?

The "rich scrapings" yield no more lead by a simple reaction, because a part of the oxide undoubtedly forms with the sulphuret, an oxisulphuret, on which the oxide does not act; it is, therefore, necessary to have recourse to charcoal for reducing the latter and liberating the sulphuret; by again roasting it, the newly generated oxide acts on the sulphuret, and thus by successive reductions and oxidations, the scrapings are exhausted of nearly all the lead. The charcoal has also the effect of rendering the mass porous and offering channels to the metallic lead imbedded in the mass for flowing into the iron receivers; indeed, both the preceding substances contained much metallic

lead, while the "poor scraps" now remaining, are almost wholly destitute of it.

This residue differs from the preceding in not containing metallic lead, and in presenting a more homogeneous appearance. Heated with black flux, it yields 5.7 per cent. of lead, which gives a button of silver by cupellation, much larger than that of the rich residue.

It contains no sulphuric acid except in combination with baryta; the analysis was conducted by first treating it with acetic acid, and then the operation was continued as in the preceding materials; there was found as in the preceding cases, it is composed of:

Oxide of lead, - - - -	0.020
Lime, - - - -	0.318
Protoxide of iron, - - -	0.062
Oxide of zinc, - - - -	0.154
Sulphuret of lead, - - -	0.050
" iron, - - - -	0.038
" zinc, - - -	0.138
Silica, - - - - -	0.056
Sulphate of baryta, - - -	0.148
Metallic lead, - - - -	0.012
	0.996

It is apparent from this analysis that the charcoal had the effect of destroying the oxide and sulphuric acid; the sulphate of baryta is, however, unaltered, which probably arises from the great resistance to decomposing agents, which natural bodies present.*

It is also worthy of remark, that this last product encloses a considerable quantity of sulphuret of zinc, the more surprising as blende is generally the first to be roasted.

Another not less remarkable anomaly relates to the silver contained in the ore, the quantity of which is small, but while the lead obtained during the first process, gives no indication of it, it is found in the other products, particularly in the last. We must, therefore, conclude, though contrary to what generally occurs, that the silver is concentrated in the last products.†

This refuse yields no more lead, because the great amount of oxidized matter prevents the ulterior oxidation of the sulphurets; instead, however, of rejecting them, they are stamped, washed and mixed, with the crude ore.

From the preceding it may be gathered that the process pursued at Bleyberg is very simple, consisting in the transformation of a part of the sulphuret into oxide, in causing these to act on each other to produce lead, and lastly, in setting the sulphuret again at liberty to enable the fresh oxide to act upon it.

During the whole of this treatment, the substances are merely softened, and preserve their sandy state, which is favorable to the successive oxidations and reductions that could not be performed on liquid or pasty masses. Care is also taken at the commencement, to heat moderately to avoid smelting the galena, and to raise the temperature gradually, and only

* The sulphate of baryta is at all times difficult of decomposition, and should be in immediate contact with the decomposing agent, which may not be the case in the above operation. Would it not, however, be decomposed if a sufficient quantity of charcoal were present?—Trans.

† It is to be regretted that the author has not presented us with an accurate analysis of the metallic lead obtained during the different stages of the process, as it might give us valuable hints in regard to theory and practice.—Trans.

in proportion as the sulphuret diminishes, for then the fusion of the substances is not to be feared.

As already stated, the roasted ore, or the scrapings, subjected to a bright red heat in a clay crucible, did not undergo fusion, which must be attributed to the sulphate of baryta, and to lime, for probably the lime added during the process, is peculiarly adapted to that purpose. This is directly opposed to the ideas of M. Tournet (in a note in Ann. des Mines, 3e, Série, T. II. "Théorie du traitement de la galèna au réverbère,"), who asserts that sulphate of baryta is added in Carinthia, to promote the fusion of the gypsum which is generated. The assertion is incorrect, for the heavy spar is found in the matrix, and if aught be added, it is lime, not however, for the purpose of rendering the gangue fusible, for it is important to prevent it, and by this very means the end is attained, for, according to Berthier, (Ann. des Mines, 3e Série, T. II.,) the sulphates of lime and baryta do not form a fusible combination.

There remains 7.3 per cent. lead in the "poor scrapings," the amount of which, retained by the different combinations it forms with foreign substances, ought of course to increase with these. A tariff is employed at the works regulating the loss of lead according to the productiveness of the ore.

When the ore contains 82 per cent. the loss should not exceed 2 per cent., 80, 3; 78, 4; 76, 5; 74, 6; 72, 7; 70, 8; 68, 9; 66, 10; 64, 11; 62, 12; 60, 13.

The poor residues were formerly treated alone, with a loss of 20 per cent. The workmen receive 2½ kreuzer, (2 sous) for every pound they obtain beyond the tariff, and pay 5 kreuzer for every pound wanting. The table shows that the loss increases in rapid proportion, as the quantity of ore diminishes, the consequence of which is, that only very rich ores can be employed in this process, and indeed they only receive such as give 50 per cent. in a small assay.

In order to bring the different ores to a convenient state of richness, they are subjected to preparatory mechanical operations, and very carefully washed; hence the work would be expensive with a high price for labour; at Bleyberg, however, a day labourer receives a very moderate compensation. It were impossible to make the ore productive in many places, even supposing wages to be very low; it is when the metallic substances accompanying the lead, such as the blende and pyrites, contained silver, in which case all these substances should remain in the ore. It follows, therefore, that the process of Bleyberg ought to be limited to certain localities, where, as in Carinthia, the contents of silver amount to almost nothing.

With regard to the advantages derivable from the Carinthian method, they are considerable, when taken in connexion with economy of fuel, as may be shown by a comparison of it with the analagous process pursued at Poullaouen. At Bleyberg eleven to twelve cubic feet of wood are consumed in obtaining the quintal of lead. According to a treatise of M. Baillot, they obtained at Poullaouen, in 1824, from an ore containing 60 per cent. lead, only 42 per cent., showing a loss of 30 per cent.; but this loss is not real, for a part of the lead is obtained on an ore hearth, though it then requires another operation. The loss at Bleyberg for ores containing 60 per cent. is only 13 per cent. In order to obtain one quintal of lead, forty-seven to forty-eight cubic feet of wood are consumed, or four times as much as at Bleyberg. Again, they destroy six pounds of iron instruments per quintal; at Bleyberg, on the other hand, only one-fifth of a pound; this arises from the

formation of much sulphate during roasting, which, being afterwards decomposed by the charcoal and iron, converts the latter into sulphuret. The Carinthian method possesses, therefore, great advantages, being convenient and easy of execution, requiring only one workman during a *poste* of twenty-one hours, the consumption of fuel and loss of lead being inconsiderable. But only small quantities can be operated on in this manner, for in twenty-one hours the amount of lead produced, does not exceed four and a half or five quintals, French. At Poullaouen, they obtain in the same time, or even in eighteen hours, twelve to thirteen quintals.

It is probable that the employment of a large furnace in this method, would destroy its advantages, the facility of labour and economy of fuel; in fact, at Poullaouen, the greatest expense for fuel is incurred during the reducing process, when the temperature must be very high, although the furnace is considerably enlarged by a diminution of the substances. At Alsau and Holzapfel, they likewise employ the Carinthian method, operating only on small quantities.

Physical Science.

ESSAYS ON METEOROLOGY.

No. IV.

North East Storms, Volcanoes, and Columnar Clouds.

If all other proofs were wanting, our great N. E. storms of six or eight hundred miles in diameter, from N. E. to S. W., and of unknown extent from S. E. to N. W., would afford us an undeniable proof of an upward vortex. These storms always set in from near the N. E. and terminate near the west. So we have proof positive, that the wind near the surface of the earth, is always blowing both east and west of the storm towards the storm itself. I have observed these storms for many years, and I have never known but two to terminate with the wind from the eastern quarter, and then the anomaly was soon explained in both instances, by another storm coming on in less than forty-eight hours. But even in these cases, after the termination of the first storm, the wind was very gentle, nearly calm.

The wind always commences from the N. E., some hours (from ten to forty) before the beginning of the rain or snow, and does not change till near the end: however, it is believed that the upper clouds during all this time, continue to come from the S. W.

They certainly do so till they are concealed from view by the lower clouds, which generally form a short time before it begins to rain, and the moment the lower clouds break away a little, near the end of the storm, the upper clouds are seen moving in the same direction. Besides, I have more than once got a peep through the lower clouds, during the progress of a storm, and discovered thick, dense, clouds above, coming from the S. W.

I have also seen instances of a strong wind at the surface, directly opposite to the motion of dense clouds above, which were evidently not very high, from their great velocity, and I afterwards learned that at the same moment there was a very great rain about one hundred miles distant, in the direction towards which the lower wind was blowing. The extent, however, of these rains, I did not learn. It must depend upon future and more extended observations, to learn whether the outward motion of the air in

the upper part of the vortex, extends beyond the boundary to which the inward motion of the air below reaches.

On the ocean, it is known that these storms are attended with immense swells reaching beyond the agitation of the atmosphere. This effect is probably much more dependent on the diminished pressure of the atmosphere on the ocean under the vortex, than on its horizontal velocity. For a fall of three inches in the barometer will cause a rise of the water of more than three feet to produce equilibrium, and as the waters would move in all directions towards the point of least pressure, their momentum would cause a rise two or three times this quantity independent of the effect caused by the friction of the air. How far the reciprocation of this wave would extend, I am not at present able to say. I think I have read of considerable elevations of the water, at one end of the lake of Geneva, which were evidently not produced by the wind blowing over the surface of the lake in a direction favourable to such an elevation; if there was a spout passing, near the time of the elevation, it would account for the phenomenon. Indeed, if the spout should even pass over the middle of the lake, and the barometer should fall there three inches, it would cause such a swell that its reciprocations would reach its extremities after the spout had passed away, and thus these swells would appear to take place in the midst of a calm, and so be apparently unconnected with the wind. Mr. Dalton informs us that the surface of Lake Derwent is sometimes agitated, when no wind can be perceived, in so violent a manner, that it exhibits large waves with white breakers. The phenomenon is called a bottom wind; but the cause of it is utterly unknown. Lake Wetter, in Sweden, is affected in a similar manner.* The theory of upward vortices shows how such an effect might be produced.

Even as to the barometer itself, I have not seen any theory which is able satisfactorily to account for its great and sudden falls. It cannot be the diminished pressure which takes place from the deposition of rain, for if ten inches of rain were to fall so suddenly that the air would not have time to rush in and restore the equilibrium, it would not cause the barometer to fall one inch.

Indeed, so great has been the difficulty on this point, that the author of the Art. Physical Geography, in the Edinburgh Encyclopædia, thinks these depressions are caused by the destruction of large portions of the air in the higher regions of the atmosphere by electricity acting on the combustibles which ascend there from the earth. I need hardly add that this phenomenon is a corollary from the theory here advanced.

It has been thought also, that the centrifugal force of the wind blowing over the curvature of the earth's surface, might cause these great depressions of the barometer. But if we suppose the whole of the air in motion with a velocity of one hundred miles an hour, and calculate its centrifugal force according to the principles laid down before, its gravity would be diminished when the wind was west, only about one hundred thousandth of its whole weight, which would cause the barometer to fall .0003 of an inch; and if the wind is east, it will readily be perceived that its gravity will be increased to the same amount. The theory will also account for the great depression of the barometer, which is known sometimes to accompany the action of volcanoes.

On the 19th of December, 1821, a violent eruption commenced from the old volcano Eyafjeld Jokkul, in Iceland, which had been quiet since the year 1612. On the very day of the commencement of the eruption the

* Ed. Ency. Art. Physical Geography.

waters of the rivers which descended from the surrounding mountains, were considerably increased. All over Europe dreadful storms of wind, hail and rain succeeded the commencement of this eruption. On the 24th, particularly, extraordinary devastations were experienced in very distant parts of Europe, and generally, wherever the hurricane appeared, deluges of rain accompanied it. At Genoa, and many other parts of Italy, the storm is described as particularly severe, (wind S. and S. E.,) many parts of the country and the roads being entirely submerged; and the next day, the 25th, the barometer fell unusually low all over Europe, including Great Britain. Now it is highly probable, that the eruption of the volcano threw out immense quantities of vapour, and if so, the condensation of this vapour would heat up the atmosphere by the evolution of its latent caloric, as was explained before, and this heated air would rise and spread out in all directions; and a vortex being thus established and kept up by the action of the volcano, both by mechanical force and by a diminution of specific gravity, the air rolling out on all sides above, and pressing in on all sides below, a general rain would be the consequence, and this rain might spread out so far from the centre of action, as to reach even the south of Europe in five days. The barometer continued to fall, in Iceland, from the day before the appearance of the volcano, till the twenty-sixth day after it was at the lowest in different parts of Europe, and two days after the prevalence of great storms in Italy and France. During all this time the volcano was in active operation, and even as late as the 23rd of February, it emitted smoke greatly resembling steam of boiling water. The whole quantity of rain which fell from the 19th till the 24th, must have been very great; for even as far south as Genoa, the air, for several days previous to the 24th, when the great tempest occurred there, had been filled with thick vapours, which vented themselves in torrents of rain, and the wind blew from the south with intense violence. This south wind would bring from the Mediterranean an immense quantity of vapour, to be condensed when it entered into this vast upward vortex. Let us suppose then, what is certainly within bounds, that five inches on an average of rain, fell over the surface of Europe, from the 19th till the 24th, or the morning of the 25th; and in Paris, where the flood was not as great as in many other places, there fell 6.4 inches. From the principles explained before, the caloric given out by the vapour in condensing into rain, would heat the whole atmosphere 11.4° for every inch of rain, or in the present case 57. degrees. And as the mean temperature of the air was certainly below 32° the expansion due to this increase of temperature would be more than $\frac{57}{480}$ of the whole, which would cause the air to stand at its surface five and a half miles higher over the region where the rain had been deposited, than in surrounding countries, provided it was forty-five miles high before the deposition, and none had flowed off.

This last supposition, however, cannot be true, for the moment it began to swell up by expansion, it would begin also to flow off, and the depression of the barometer would be in proportion to the quantity rolling off above, greater than that which ran in below towards the point of least pressure. This difference would be considerable for two reasons: first, the air below would not begin to run in until the air above had rolled out; for a mere expansion and swelling up of the air would not diminish its gravitation; and second, its resistance would be less from friction than the lower air would experience rubbing along the surface of the earth. Besides, its outward motion from the centre of the vortex, would not so much be a rolling

down an inclined plane in consequence of its being swelled into a greater perpendicular height, as a shoving out of the surrounding air at an elevation of about three and a half miles and upwards, where the air in the vortex would overbalance the surrounding air, as will easily be conceived by any one who will consider the effect of an up-heaving of the atmosphere by expansion. From all these causes facilitating the outward motion of the upper air in the vortex, it is probable that at least one half of the quantity of air elevated in the vortex above the surrounding air, by expansion, would flow off, and if so, it would cause a depression of the barometer, within the region of the rain, of more than one inch and a half. And this corresponds with the depressions given in many places.

This depression would cause a velocity of the air at the surface of the earth, on the outside of the vortex, towards the centre of rarification, of 114 miles per hour, if there was no friction; but as the friction at the surface of the earth is very great, the velocity would probably not be more than one half this quantity, or fifty-seven miles per hour. This velocity would not be sufficient to produce the overflowing of the sea at Genoa, Leghorn and Trieste, but if to the force of the wind, we add the diminished pressure of the air along the northern shore of the Mediterranean and of the Adriatic, and the increase of the pressure of the air on the outside of the storm, by the rush of the air outwards above the rise of waters, there might be quite sufficient to produce the disastrous effects which spread consternation over so much of the southern part of Europe.

Was the remarkably warm winter of 1821 and 1822, in all the north of Europe, caused by the immense quantity of latent caloric given out during these great rains, together with the southern winds which prevailed in consequence of the upward vortex of air over Iceland during this whole winter? At St. Petersburg, dreadful floods of rain repeatedly occurred during the winter, and the snow had entirely disappeared by the first of February; and even beyond Tobolsk, warm winds prevailed, and generally in the interior there was no snow. And on the 2d of March, the Dwina was free from ice at Riga.*

If this were the only fact on record, of rain accompanying volcanoes, it ought in this case, to be considered accidental and unconnected, but nothing is better established than the connexion of volcanoes with rains, from their very frequent concomitancy. Indeed, Baron Humboldt, speaks of the mysterious connexion of volcanoes with rains, and adds, that they sometimes on breaking out change dry seasons into rainy in South America. This connexion will be considered mysterious no longer. It may here be added as a reason why volcanoes do not always produce rains, that in the most unfavourable state of the dew-point, rains cannot be produced.

Volcanic eruptions are sometimes attended with tornadoes. In the Island of Sumbawa, eastward of Java, a most dreadful volcanic eruption commenced from the mountain of Tomboro on the 5th of April, 1815, and was most violent on the 11th and 12th. Out of a population of twelve thousand persons only twenty-six escaped destruction. Violent whirlwinds swept away men, horses, cattle, and every thing which came within their vortex, tore up the largest trees, and covered the neighbouring seas with floating timber, that had been scorched in passing through the flames.

These volcanic vortices sometimes carry up the drops of rain high enough to freeze them. The Rev. W. B. Clarke, says in the Magazine

* See Phil. Journals of 1822.

Nat. Hist. vol. vii, page 300, " that Mr. Kelsall, who was an eye witness of the great eruption of Etna in 1809, writes thus: At fifteen minutes past 9 A. M., April 1st, a quantity of dense vapour or smoke proceeded from two rents, which rose to a considerable height in the atmosphere, before serene, was dilated, and formed a black cloud above 2000 paces in diameter, which presently discharged a copious shower of large hail stones, on the red hot lava. In the same page he says, that during an eruption of a volcano in Iceland, in 1793, not only did rain fall in torrents, but also hail in showers.

Mr. J. R. Jackson, in his Aide-Memoire Du Voyageur, says, "I have seen in the planes of Agra, Hindostan, Lat. 27°, enormous columns of sand, sometimes thirty at a time, several feet in diameter, rising perpendicularly out of sight, and followed frequently by a shower of large hail stones, containing such a quantity of sand in large grains, that in filling a goblet with this hail, when it was melted, there was a sediment of sand almost half an inch thick.

From these accounts it is manifest that hail is sometimes produced by an upward motion of a column of air, both with and without volcanic agency. That snow is produced, and even not permitted to fall down in the region of the upward motion when that motion is very rapid, is abundantly proved by the following facts:

In Scoresby's Arctic Regions, vol. I, page 404, the author says, "About 10 h. the snow abated, and several ships were seen about three or four miles off. As all these ships were sailing on the wind, it was very easy to ascertain the direction of the wind where they were. Two ships bearing N. E. from us had the wind N. E.; two bearing E. at E. or E. N. E.; two bearing S. E. had the wind S. E. while with us it blew from the N. W.

In each of these places a fresh breeze prevailed; but in some situations where there happened to be no ships, there appeared to be no wind at all. The clouds above us at the time were constantly changing their forms, and showers of snow were seen in various places at a distance." At another time, he says, "while a gentle breeze from N. prevailed with us, a heavy swell from the S. S. E. came on, and a dense black cloud appeared in the southern horizon, which rapidly rose into the zenith and shrouded one half of the heavens. The commixture of this dense air with the cold wind from the N. produced a copious discharge of snow. When the snow ceased, (though we were nearly becalmed,) we observed several ships a few miles to the south-eastward under close-reefed topsails, having evidently a gale of wind, blowing in the direction of the swell. In about two hours the southern wind reached us, and as we stood to the eastward, gradually increased to a gale. Previous to this storm the barometer fell three-fourths of an inch in twelve hours. Now as the wind in both these storms blew towards a particular point from all sides round, it must have blown upwards at and over that point, and hence the snow was not permitted to fall there, but fell at "various places at a distance."

It is equally clear, that a strong gale could not blow towards Captain Scoresby in sight of him for two hours, before it reached him, without blowing upwards at some point between him and the ships seen labouring in the gale.

A remarkable circumstance, which I think can only be explained on the supposition that the cloud mentioned moved upwards, is related in the next page. He says, "my father was engaged on a particularly fine day in admiring, from an eminence of 2000 feet on Charles Island, the extensive prospect, when the rapid approach of a small cloud attracted his attention ;

When it reached the place where he was setting in a calm air, a torrent of wind assailed him with such violence that he was obliged to throw himself on his body and stick his hands and feet into the snow, to prevent himself from being hurled over a tremendous slope which threatened his instant destruction. The cloud having passed, the air again became calm, and he immediately descended." Now this is just the effect which a large mass of air would produce by moving upwards rapidly, from being of less specific gravity than the surrounding air, which is too plain to need demonstration.

This cloud was probably formed in the following manner: Air at the surface of the ground below became heated, as it always does in clear, calm days, some degrees hotter than the air a little above the surface, and thus produced an unstable equilibrium, so that the least agitation would cause an upward motion to commence at the point of greatest heat, especially if that point contained a higher dew point, as it generally does. As soon as this motion commenced, other air rushed in below, and the higher and longer the column of heated air became, the more rapid would the upward motion become, and finally, after the upper end of the column was as many hundred yards high as the temperature of the air on the ground was above the dew-point in degrees of Fahr., the cold produced by the expansion of the air, would begin to condense the vapour and form clouds; and still as other air rose to that elevation it would begin to condense likewise, and thus the base of the cloud would remain at the same elevation, while the cloud would go on increasing in perpendicular height above. This is the kind of cloud which is formed almost every clear day in the summer when the dew-point is not very low, but never forms when it is over cast. When the air is calm, if these clouds are observed carefully when they are forming, they will be seen to increase in perpendicular height while their bases remain at the same level. They rise in the form of pyramids or cones, with dense, well-defined outlines, as white as snow. If they do not meet with an upper current causing their tops to lean in the direction in which it is moving, they rise perpendicularly, and as they are broad enough even at their tops to lift up before them a considerable mass of air, it sometimes happens that in reaching strata of air highly charged with vapour it lifts them to a higher elevation and causes a thin streak of cloud to be formed at some distance above the top of the columnar cloud. This streak so formed I have denominated a *cap*. It is generally a little curved convex above and concave below, and as it moves slower upwards than the columnar cloud, the latter overtakes it and passes through it. Meanwhile the cap appears like a thin vapour spread over a mass of snow. Sometimes when a columnar cloud is very strong and rapid in its ascent a second and even a third cap is formed, with similar appearances. When this happens, rain from the cloud is certain. First, however, the top of the cloud is seen to change its dense and well-defined appearance and become hazy. This is a sign that the cloud is about to rain, and in a few minutes, if the cloud is favorably situated, rain will be seen descending from its base. These appearances are all best seen when the base of the cloud is a few degrees above the horizon. The top of the cloud as it hazes is generally, in this climate, carried off by the upper current towards the N. E. and forms that feathery cloud which is so different in appearance from all other clouds. It is the highest of all the clouds except the tops of these columnar clouds, which generally rise through it.

In passing through it the columnar clouds generally form a very dense cap, and are sure to haze and rain soon after their passage. After they

begin to rain they soon cease to rise; but other columns spring up contiguous to them, generally on the S. W. side of them, as far as I have observed, and as theory seems to indicate, and go through the same process of cap-forming, hazing and raining as the parent cloud.

These new columns when they first make their appearance I have denominated *sprouts*. This name is not inappropriate, for these sprouts are evidently generated, or at least assisted in their growth, by the parent column, in the following manner. As the parent column rises into the upper current of air, which generally comes from the S. W. or W. S. W. its top is made to lean towards the N. E. or E. N. E., but by its inertia it causes the current there to run a little slower, and so the column which may be about to form behind it towards the S. W. finds less difficulty in rising, and preserves a more erect position, and thus can attain a greater elevation. Hence, the first attempts of columnar clouds to rain are generally failures, because their tops are generally shaved off or pressed over towards the N. E., and thus dissipated without raining: each succeeding cloud in its wake finding a stiller air in its upward motion attains a greater elevation. Finally, one reaches a height sufficient to produce rain, and then a new source of power is called into action, powerfully aiding the formation of sprouts. This is the descending rain cooling the air below the cloud, and causing it by its greater specific gravity, and also by the weight of the drops of rain, to move outwards in all directions from the centre of the rain.

Now as the air all round the parent cloud is running in at the base of the cloud and below towards the cloud, this air is obliged to rise up over the stratum of cold heavy air, pressed outwards around the borders of the shower, and thus its upward motion is increased; and as the dew-point is more likely to be higher on the south side of the cloud than on the north, sprouts will on that account be more likely to form on the south than on the north. To see the formation of sprouts to the greatest advantage then, the cloud should be to the north of the observer.

If these theoretical deductions are correct, and as far as observation extends it does not contradict them, it would follow, that the progress of rain may be from a northern direction, though the upper current may be constantly carrying the hazy cloud formed from the tops of all these columns towards the east. Further observations are wanting on this point.

I would recommend that gentlemen residing in mountainous districts, where the clouds sometimes form on the sides of the mountains, should ascertain the perpendicular height of these clouds at their base, and see whether they are one hundred yards high for every degree of Fahr. which the temperature of the air is above the dew-point at the moment of their formation.

If gentlemen have no means of taking the dew-point directly, the following method will be found equally correct in ascertaining the height of the base of these particular clouds, at any time of the day, for the height varies every hour. Swing a thermometer (Fahr.) rapidly in the air to avoid the effect of radiation, note its temperature, then cover its bulb with a wet rag and swing it as before until it sinks as low as evaporation can make it, then divide one hundred and three times the difference of these temperatures by the wet bulb temperature, the quotient will be the height of the base of the clouds in question, in hundred yards. For example, suppose the dry bulb is $56\frac{1}{2}°$ and the wet one $51\frac{1}{2}°$, then the base of the clouds will be 1000 yards high. This height is calculated on the supposition that air cools at 4° Fahr. in

ascending to a height where the barometer would be one inch lower than at the surface of the earth, and 4° more for every additional inch. If this latter law is not strictly correct, the height of the base of the cloud in question will vary accordingly, and the law itself may be accurately investigated by this method, for the precise degree of refrigeration necessary to condense vapour at a particular dew-point is known, after making an allowance for the expansion of the vapour itself and the fall of the dew-point on this account. As the discovery of a method to ascertain by the thermometer, the height of a particular kind of cloud easily distinguishable from all others, is a matter highly curious in itself, independent of its connexion with the theory here advocated, it will no doubt receive that immediate attention which it deserves.

Franklin Institute.

Committee on Science and the Arts.

Report of Committee to try experiments with Spark Arresters.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination, by experiments, the apparatus for stopping the sparks from issuing from the flues of Locomotive Engines, submitted in competition for the premium offered on behalf of the Newcastle and Frenchtown Turnpike and Rail Road Company, REPORT:—

That, from the plans submitted in competition for the offered reward, they selected three of the most promising, which they recommended the respective inventors to put in order for trial; at the same time they informed the other competitors that theirs also would be tried, if they requested it.

Through the liberality and kindness of the Beaver Meadow Rail Road Company, and the Philadelphia and Trenton Rail Road Company, the Committee have been favored with the use of the engine of the former, and of the road of the latter for making their experiments. One of the plans selected having been withdrawn, and none of the others claiming the privilege of a trial, there remained but two to be subjected to a practical test, viz: one invented by Jas. P. Espy, Esq. and the other by Mr. S. Gerhard.

The one by Mr. Gerhard, consists of a series of revolving fan wheels placed horizontally one above the other near the top of the chimney or smoke pipe, the wheels or fans were placed nearly in contact one above the other, having just sufficient space to admit of motion independently of each other, and the twist of the fans reversed in the middle one, so that its revolution should be in the opposite direction from the other two. The revolving motion to be produced after the manner of a smoke jack, by the current of air and steam passing up the chimney.

This apparatus was first put upon the engine and the fire attempted to be made, but it was found that owing to the too small capacity of the passage through the fans, the firing was difficult and tedious, and that it was impossible to keep up the steam for a moderate velocity of the engine and tender. The effect in arresting the fire sparks was rather unexpected, as not a single spark was seen to make its escape, although care was taken to use such fuel as would furnish them in the greatest profusion. This result could only be ascribed to one of the three following causes, either the ope-

ration of the fans had been effectual in beating back and destroying the sparks, or as the engineer who accompanied the Committee supposed, the obstruction to the draft being great the steam was necessarily so damp as to extinguish them, (and being in the night time they were invisible,) or what was considered highly probable, the obstruction was so great as to prevent the creation of an upward current sufficiently powerful to raise the sparks to the top of the chimney, and that any other obstruction operating in the same degree, would be attended with the same results. Accordingly, at a subsequent trial, a piece of sheet iron eight inches wide was secured across the top of the smoke pipe leaving an opening on each side three and a half inches wide, with the intention of making about the same amount of obstruction as had been caused by the before mentioned fans. The result of the experiment was nearly similar. The obstruction in the latter case was evidently, from other indications, not quite so great as in the former, and a very small number of sparks occasionally made their appearance. Whilst the committee acknowledge that their experiments go no farther than to show that the favorable results obtained by the inventor, previously to his submitting it to the examination of the Committee, and that obtained by the Committee as above mentioned, may have been owing rather to its efficacy as a *draught obstructor*, than to any good principle of action as a spark arrester, they can see no good reason for advising the inventor to incur the further expense of constructing one of larger dimensions, being persuaded that one of sufficient capacity to allow a free passage of the smoke and escape steam, would be attended with little or no impediment to the sparks.

The apparatus, called a draft-increasing chimney cap, invented by J. P. Espy, Esq., is of sheet iron, in the form of a cone, and is placed upon the top of the smoke pipe, with its axis horizontal and its lower side pierced about midway to receive the upper end of the pipe. The base is open with the exception of a wire-gauze covering, which is intended to retain the sparks within the cap. It is intended to turn upon a swivel and be governed by a vane, so as always to present the apex of the cone towards the wind; the intention of which arrangement is to create a partial vacuum at the base of, and within the cone, to compensate for the obstruction consequent upon the use of the wire-gauze. The Committee upon trial, found that this apparatus did produce the effect of increasing the draught to some extent, but although the gauze used was of the finest kind in use, No. 19, or 19 meshes per inch, yet the sparks found their way through in sufficient quantity to be troublesome. How far the draft-increasing property of this cap may operate, to compensate for the resistance of the gauze, when that shall be of sufficient fineness to effectually prevent the escape of sparks, the Committee have not the means of judging with any degree of precision, but they incline to the opinion that the compensation would not be complete without such an arrangement as would render the apparatus inconvenient if not unmanageable, particularly on roads which require the pipe to be dropped for passing under bridges. An objection arises from the circumstance of the sparks, dirt and water, when any such escape, being thrown backward, and consequently more likely to incommode the engineers, than when discharged from the top upward, and all around the sides. There seems, likewise, a want of some means of disposal of the sparks arrested, as they are necessarily retained against the gauze until they become so much reduced by combustion as to be forced through it, and likewise of a trap or valve to remain open when the draught is not urged by the exhaust steam. Upon the whole, the Committee are of the opinion that this arrester

does not come within the terms and conditions of the offered premium, and though they confess, that the trials have not been sufficiently numerous and diversified to enable them to speak with certainty as to its comparative merits, yet they feel constrained to say, that they do not perceive how the objections already alluded to, can be so far removed as to bring it into competition with one or two which have been since invented.

The thanks of the Committee are due to Messrs. Garrett and Eastwick, for their kindness in keeping the locomotive, at their own risk, for the accommodation of the Committee.

By order of the committee.

August 11, 1836. WILLIAM HAMILTON, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN FEBRUARY, 1836.

With Remarks and Exemplifications by the Editor.

(CONTINUED FROM p. 195.)

59. For *Sawing with a Band Saw;* William Carey, Poughkeepsie, Dutchess county, New York, February 17.

The patentee claims as his invention, "the band saw running on two wheels, and the arrangement of the machine in which it is to operate." For the validity of which claim, see our remarks upon the patent of Benj. Barker, p. 112 of the present volume; every remark respecting which applies fully to the present patent.

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60. For *Cannon for firing chain shot;* Edward Gordon, Hingham, Plymouth county, Massachusetts, February 17.

A double barrelled cannon is to be made, one vent discharging each. A ball is be put into each gun, the two being connected by a chain of sufficient length to admit of this. The guns are to diverge a little, in order to stretch the chain before the balls reach their intended object. There is not any claim made, but the patentee descants on the use of his invention, and the destructive effects of balls so connected, as though chain shot had never been used. Now it certainly behooves a man, before he attempts to improve a system of any kind, to acquire some knowledge of what has been previously done, for, when science and interest have long been combined in order to obtain the best results, it rarely happens that an indifferent person will stumble upon any great improvement, all vulgar adages to the contrary notwithstanding.

We do not know that chain shot have been fired from double barrelled cannon, nor do we believe that they ever will. We offer the following opposite quotaion from "L'Allemand's Artillery." "The Annals of Paris and Vienna alone, are crowded with contrivances, all curious in their way, but offering models that do more credit to the imagination than to the judgment of their authors. Among a thousand inventions, or fancied improvements, it is difficult to find a single one that has not already been made and

condemned; and even if it be new, it cannot be admitted into a system until it has been submitted to practice during the course of a war."

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61. For a *Machine for hulling Clover Seed;* John B. and William F. Poague, Lexington, Rockbridge county, Virginia, February 17.

A conical stone is to revolve is a corresponding hollow cone of the same material. The mode of fixing, driving, &c., are all quite antique; and the claim is to the "before described machine;" which claim may be perfectly correct, if by the before described machine, we are to understand a machine which has been repeatedly before described.

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62. For a *mode of fastening Mail Bags, &c.;* Ira Atkins, Hanover, Grafton county, New Hampshire, February 17.

There is to be a lock, with a bolt, shot forward by a key in the usual way, but to the end of the bolt is to be hinged a flat plate of iron, which is one of a series hinged to each other, and forming a chain, or flat strap, each plate has a tongue on it which is to shoot into a staple; a row of such staples being fixed on one side of the bag, and passing through openings on the other side. The claim is to the whole arrangement, with the exception of the ordinary lock bolt. The contrivance appears to us to be one which will be more troublesome than useful.

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63. For a *Mortice door latch;* William Coover, Erie, Erie county, Pennsylvania, February 12.

This mortice latch, or bolt, presents no feature of novelty, nor is any part of it claimed. It consists merely of a bolt with a zigzag spring behind it; the bolt being contained in a suitable case, and having a tumbler, and handle, by which it is to be acted upon.

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64. For a *Spark Extinguisher;* Abraham McDonough, City of Philadelphia, Pennsylvania, February 17.

In this spark extinguisher there is to be a lining of sponge within the cap which constitutes the upper part of the chimney, and this lining is to be kept wet by the percolation of water through small tubes in the bottom of the trough, which is fixed at the upper edge of the cap; there is to be a water trough also at the lower end of the cap, into which sparks are to fall. The description and drawing, although not models of clearness, may suffice to enable a shrewd workman to construct the apparatus, but there is not any thing to guide us to a knowledge of what is claimed; it cannot be the use of water, and the lining of the cap, as these are not new, and this lining and upper trough may, according to the patentee, be omitted. We are apprehensive, however, that amending the specification would not remove the main difficulty, as it will not enable the machine to attain the proposed end, which we very much doubt its ability to do.

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65. For an improvement in the manner of *raising and depressing the steam and exhaust valves of Steam Engines;* William Duff and Thomas Murphey, City of Baltimore, Maryland, February 17.

The object of this arrangement appears to be to operate upon the induction and eduction puppet valves by rods acting in a direct line. The claims are, " First, the arrangement of the valve-stem in the top-chest, in an inverted position, so as to be connected by means of the rod with the

stem of the valve of the lower chest, in a direct line. Secondly, the connection by means of the straps, as set forth, of the stuffing box of the female stem of the top chest, which box is also inverted, so as to be thus connected in a straight line with a stuffing box of the lower chest; and, finally, the adaptation of the two connected rocking shafts as described, to produce by means of the lifters and lugs, the alternate motion of the stems and straps."

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66. For an improved *Tire for Carriage Wheels;* James H. Rogers, Mount Morris, Livingston county, New York, February 17.

The tire is to be made hollow on the inside, so that its cross section shall present a curve, or two straight lines, forming an obtuse angle in the centre. "The use or application of the hollowed or grooved tire, for the purpose of carriage and other wheel building generally," constitutes the claim.

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67. For an improvement in the *Manufacture of Starch;* Walter and Thomas Leveredge, Dorchester, Norfolk county, Massachusetts, February 17.

"We claim a patent for manufacturing starch from rice, or for the application of rice as a substitute for other substances heretofore used in the manufacture of starch." Whether so broad a claim as this can be sustained is a very doubtful point. Rice is the principal food of a very large portion of the human race, and is, by millions, eaten to the exclusion of nearly every thing else, and that among a people who use starch largely in their manufactures; we have not at hand, or in memory, any direct information on the subject, but the probabilities are much against the absolute novelty of the manufacture.

The process followed by the patentees, but not claimed, is the following: fifty pounds chloride of lime are dissolved in one hundred gallons of water, and to the liquid when drawn off clear, eight pounds of sulphuric acid are added. Upon any quantity of rice as much of this liquor is to be poured as will just cover it, and it is to remain, with occasional stirring, for forty-eight hours. The liquid is then to be drawn off, and the rice ground, with water, to about the consistence of cream. To every one hundred gallons of this liquid, as much water is to be added, after which it is to be strained through a bolting cloth, to be allowed to settle for twenty-four hours, the clear liquid drawn off, and the starch dried.

We do not understand the chemistry of this proceeding, the first step of which is to make, and to destroy, a solution of chloride of lime.

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68. For a *Rotary Steam Engine;* Aaron Clark, Bangor, Penobscot county, Maine, February 17.

The construction of this engine is, in nearly all its parts, the same with that of many others of the rotary kind. A stationary and a revolving cylinder are employed, the latter being within the former, and furnished with two sliding valves capable of being forced into the body of it, by that portion of the outer cylinder which projects into the chamber for that purpose. These valves are widened on that edge which is within the inner cylinder, and upon these ends the steam is admitted, and is, by its pressure, to force them out. The claim is to "the mode in which the floats are forced out and into the revolving cylinder." The advantages pointed out

by the patentee are the same as those anticipated by the projectors of rotary engines generally, and, generally, terminating in disappointment.

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69. For a *Truss for Hernia;* William Adair, Pleasant Hill, Monroe county, Kentucky, February 17.

A straight strap, partly of leather, and partly of India rubber, is to pass round the body, and to have on it a wooden pad, covered with buckskin. Two narrow straps are to be used to keep it in its place, one passing round the thigh, and the other over the shoulder. This truss, we are told, "causes a pressure in the direction of the *abdominal canal,* [qu] by the inelastic hard wooden pad, thus effecting a permanent adhesion of the parts, &c." The claim is to "the before described truss." Such a truss is worthy of such a claim, as it is not distinguishable by any novel or good feature.

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70. For an improvement on the *Paper making machine;* Charles Forbes, administrator of Robert Rose, deceased, East Hartford, Hartford county, Connecticut, February 20.

An endless webb of wire fourteen feet long, is to pass round two rollers so situated that the upper surface of the webb shall form an inclined plane; eighteen or twenty small rollers are used to support this webb on its under surface, and the lower end is to form a part of one end of a vat containing the paper stuff. The claim is to "the sustaining the webb in a slanting position, so as to form the end, and in part, the bottom of the vat containing the stuff, or pulp, so that the pulp, by means of the water draining through the webb, may be properly deposited on the webb for the formation of paper."

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71. For an improvement in *Spectacle glasses;* Isaac Schnaitman, Northern Liberties, Philadelphia county, Pennsylvania, February 20.

Many persons have been in the habit of using segments of two glasses in each eye of spectacle frames, the segments being of different focii, so as to adapt them to distant or near objects. The patentee, instead of having divided glasses, grinds each glass so as to have two focal centres, and claims "the invention of grinding two separate and distinct focii in one piece of glass, adapted to various optical purposes, but principally to be used and applied as spectacle glasses."

We think this specification imperfect, inasmuch as it only informs us respecting the end attained, and leaves us in the dark as regards the means of arriving at it; the decisions say that a patent cannot be sustained for a result merely, but that it must be granted for the means of accomplishing it; and it will not be pretended that glasses, such as are here described, can be ground by the ordinary tools, or by the ordinary manipulation.

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72. For a *machine for Sawing Staves;* Aaron Bard and Simeon Heywood, Lunenburg, Worcester county, Massachusetts. First patented July 8th, 1834. Patent surrendered, and re-issued February 20.

We noticed this patent at page 93, Vol. xv, and mentioned the existence of a previous one for the same thing. The patent has been surrendered for the purpose of claiming those particular things in which the present patentees view their improvements as consisting; namely, "the manner of running the saw on friction wheels, lapped by each other; also the flanch,

or flanches, to keep the saw from running off its bearings; also the slide boxes for the axles of the friction wheels to run in and set them to the saw."

The saw is a complete hoop, which was included in the patent of Sumner King, noticed in Vol. xiii, page 121, and believed to be new; if this opinion was correct, it is presumed that the present patentees have acquired a right to it, without which their improvements would be of no value.

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73. For *Supplying Salt;* Peter Cooper, New York.

This has been registered in the Patent Office by mistake, the patent not having issued; and it is to be hoped that it never may, as the plan proposed is one which caps the climax of absurdity, being no other than to convert the water of our canals into brine, in order that salt may thereby find a cheap and easy conveyance.

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74. For an improvement in *Suction and Forcing Pumps;* Thomas C. Barton, Washington, Warren county, New Jersey, February 20.

This patent is not taken for any improvement in the principle of construction, but for certain modes of putting the parts together; these improvements are described as to be applied to a double cylinder pump, such as is generally employed in fire engines, and without the drawings an attempt to describe them would demand too much space and time for the subject matter.

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75. For *Hollow Cylindrical Flyers,* to be used in manufacturing yarn and thread; Samuel Ladd, Waltham, Middlesex county, Massachusetts, February 20.

The *hollow cylindrical flyers,* is merely a cylinder which surrounds the spindle, in the manner of the cap spinner, and we are unable, from the description, claim, or drawing, (or rather scratching,) to discover where the novelty, or invention, lies.

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76. For a *Saw Mill wherein hand saws are used for cutting off cross sections of wood;* Rufus Ricker, Dexter, Penobscot county, Maine, February 20.

The claim made is to "the described combination of levers to moving hand saws, (either one or more,) for sawing cross sections of timber or other substances." It does not appear, however, that the cross cutting is to be effected by *hand saws,* but by frame saws, moved by a combination of levers not specially meriting a description.

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77. For a *Wash for curing fever sores, King's evil, and most kinds of old sores;* Reuben Rood, Lisle, Broome county, New York, February 20.

"Take $2\frac{1}{2}$ drams of blue vitriol, 4 drams of allum, 6 drams of loaf sugar, dissolve them in one pint of good vinegar; add three table spoonsful of honey, and the mixture is fit for use. Keep the sore clean, and wash it twice a day with the above mixture until completely healed."

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78. For an improvement in the art of *Constructing Clocks;* William Pardee, Poughkeepsie, Dutchess county, New York. First patented May 22d, 1835. Patent surrendered, and re-issued February 25.

A notice of this instrument, as originally patented, is contained in Vol. xvi,

page 401. In the present patent the title is changed from an improvement in the *construction of time pieces*, to that of *the art of constructing clocks;* this is certainly no improvement in nomenclature as the affair is not a clock, there not being any striking movement whatever, but simply a watch, or time-piece, movement. The following is the claim now made, or, which is the same thing, an exposition of what are deemed its characteristics.

"The principle of this improvement consists essentially in this, that it is a combination of a clock movement, in which the force is applied to the arbor that carries the minute hand, substantially as aforesaid, whence the force is communicated by wheels and pinions to the hour hand, and to the pallet wheel, where it is regulated by a pendulum of any convenient structure, with a clock case, or front, cast in any convenient form, in one piece, substantially as aforesaid. The force may be by weight and pulleys, or by spring."

That which appears to be considered an essential difference between this and other time pieces, namely, the application of the power to "the arbor that carries the minute hand," is not new, this having been done by Dr. Franklin in a time piece of his contriving. See article "Clock" in Rees' Cyclopædia, and most other works treating upon Horology.

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79. For a *Copper Still*, for the purpose of running alcohol from whiskey. First patented October 22d, 1834. Surrendered and re-issued February 20.

This patent is taken for an improvement upon a still patented in Europe, and known under the name of Saintmarc's still. The claims to improvement consist in "the particular manner of arranging the tubes and caps throughout the series of chambers, and the addition of the first, or goose neck, condenser, and its appurtenances, in the manner, and for the purposes set forth." The original still has been figured and described in the English Journals, and those interested in such matters may learn its construction by consulting them; the improvements would require a drawing for their illustration.

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80. For a *machine for Thrashing out Clover, and other small seeds;* James Cooper, Greene county, Ohio, February 20.

A cylinder is to be made of wood, armed with strips of iron, which are to rub the seeds against a concave placed under it; the concave is to consist of straw, broom-corn, or other fibrous substances placed endwise in a box, and compressed firmly together, the surface of which must, of course, be cut into such a form as will adapt it to the cylinder. The claim is to "the mode described of making the concave, or bed, of straw, broom-corn, split wood, bristles, split whale bone, or of other similar materials; also the mode of ironing the cylinder."

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81. For a *Winnowing Machine;* David Wilson, Johnson, Franklin county, Vermont, February 20.

This is denominated a *horizontal* winnowing machine, and it receives this name, we suppose, from the fan being made to revolve horizontally, to do which its shaft is acted on by bevel gear. This appears to be the only thing about it which stands a chance of being called new, and even this, it seems, was, correctly, accounted unworthy a claim, which extends only to "the arrangement and adaptation of the several parts of the before described horizontal winnowing machine."

82. For an *Injection Apparatus;* Joseph Ralph, New York, February 25.

A very formal description is given of this instrument, which is intended for administering injections in diseases of the urethra. It consists of an India rubber bag, with an ivory female screw tied in the mouth of it, which is to receive a stopper, to retain the water put into it, "which water is intended to be converted into a lotion by the admixture therewith of certain powders prepared for this purpose." Other letters patent are to be obtained for these *certain* powders, of which due notice will, no doubt, be given and properly displayed, in the public newspapers.

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83. For a *Truss for Hernia;* Francis Hollis Newman, Huntsville, Alabama, February 25.

In this truss the main novelty consists in making the pad of some flexible material which is impervious to air or water; which pad is to be kept distended by one or other of those fluids. Where pressure is required from a less yielding material, a cap of metal is to be placed over the pad. The particular manner of confining the pad to the body is described, but in this there is not any thing worthy of notice, or differing materially from what has been frequently done. A claim is made to the application of pressure by means of liquids or gases, whether combined or not with the use of hard substances.

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84. For an improved *Lathe for turning Gun Stocks;* Abner Town, Woodbury, Caledonia county, Vermont, February 25.

We are informed that "the construction of the improved lathe or machine is such that both the guide and fly wheels remain stationary, while, in the operation of turning, the pattern and block pass them; whereas in the original gun stock lathe, those wheels are movable and pass the pattern, and block, both of which remain stationary. Also, in the improved machine the pattern and block have each a separate mandrill turned by a wheel, which is not the case in the original lathe. Also the machinery attached to the carriage in the improvement is such as to produce a rocking motion instead of the swinging motion of the original lathe, &c."

We cannot attempt a verbal description of the differences pointed out in the foregoing abstract, which is to be considered as constituting the claim.

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85. For *Sawing by Lever Power;* Jeremiah Walker, Philips, Somerset county, Maine, February 25.

A pulley on a double crank shaft is connected by a strap or band to another carrying a circular saw. The two cranks on the first shaft are in opposite directions, and each of them is connected by a pitman to a horizontal lever under the frame work, so that these levers may work up and down like treadles: one of these levers is made long, and is to be worked up and down by hand, the other is short, and is loaded with a weight at its vibrating end; as the long lever is forced down the weight is raised, and as the long lever is raised, the other, with its weight, descends. This constitutes the whole affair, and he who does not pronounce the contrivance for continuing the power, greatly inferior to that of the ordinary fly wheel, knows but little of machinery.

86. For a *Cooking Stove;* Billy Titus, of Marshal, Oneida county, and Anson Titus, of Phelps, Ontario county, New York, February 25.

The claims made are to "the application of a tin or sheet iron, baker or cover, for the purpose of baking or cooking on the movable hearth, in the manner specified; and the application of a box stove of very small size, and in its simplest and cheapest shape, to cooking, as described." The stove and its fixtures appear to us so much like many others, that we cannot venture to tell what is meant by the foregoing claims.

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87. For a *Vibrating Pump;* Sampson Davis, Derby, Orleans county, Vermont, February 25.

The patentee says, "what I claim as new, is a new improvement of principle in the method of raising and conveying water, by means of the *vibrating pump.* I claim no more." This new application of principles consists of a small overshot wheel, supplied with water in the usual way, and having a crank upon one end of its shaft, which is to work the piston of a small force pump. The cylinder of the pump is made to vibrate, like that of the vibrating steam engine, and the water is to be delivered through a flexible hose, admitting thereby of a free vibration.

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88. For a *Spark Consumer;* Francis Milo, Albany, New York, February 25.

The specification and drawing of this apparatus do not render its construction clear, and the claim to "the before described apparatus" does not lend any aid in "distinguishing the same from all other things before used or known."

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89. For a *Smut Machine;* Abraham Mudge, Canajohaire, Montgomery county, New York, February 25.

"The principle which I claim to have applied to the purpose of cleaning grain from smut and other impure substances, by means of the machine above described, and which application I claim to have invented, is that of throwing the grain by means of wings, or flanches, attached to a circular plate as above described, against some hard substance with sufficient force to break smut balls, &c."

This apparatus appears to be very well calculated to effect the proposed object, and to blow off the dust from the smut and other sources, but the form of the claim is objectionable, as the same principle has been before applied for attaining the same end, and it is the particular method of applying the principle, alone, which is the proper subject for a claim.

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90. For an improvement in the *Saw Mill;* David Worthington, Peru, Berkshire county, Massachusetts, February 25.

The saw used is to be furnished with teeth on each of its edges, and is to cut the stuff as the carriage travels in either direction. There are to be two rag wheels with teeth in opposite directions, and two feed hands, one for each wheel; the double toothed saw is not new, and is not claimed as such, the claim being confined to the particular arrangement adopted for moving the rag wheels; a thing in which there is no difficulty whatever, every machinist knowing methods of accomplishing this object, which no patent can prevent him from employing.

91. For a *Bee House;* Ebenezer Beard, New Sharon, Kennebec county, Maine, February 25.

The claim made is to "the manner of constructing and arranging the hives and boxes within the house, and the manner in which the bees communicate therewith." We have no doubt that the arrangement described, is convenient and beneficial, but we do not think that it is sufficiently distinguished, in the description, from other similar contrivances, to admit of a claim so general.

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92. For a *machine for Washing and Pressing Clothes;* Caleb Angevine, City of New York, February 25.

The claim is to "the circular wash cask; the manner and mode of applying the steam; the dog or other animal power to the cylinder; together with the formation of the horizontal press, and also the perpendicular lever press, as described in the specification."

We cannot say much for the novelty of the individual things claimed, as will be evident from a brief description. There is a boiler with a furnace under it, and a steam pipe leading from it into a horizontal cylinder, within which the clothes are to be placed, and agitated by dashers, made to revolve by a winch, in the ordinary way. The pressing is effected by placing the clothes within a cylinder, and forcing them together by means of a piston, or follower; the application of dog power, is, we apprehend, a mere embellishment, giving some life to the affair.

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93. For an improvement in the *Cotton Gin;* Henry Clark, Montville, New London county, Connecticut, February 25.

This improvement consists in making the iron ribs between which the saws pass, in two thicknesses, the front being of steel, and attached to the iron by screws. The claim is to "the making the ribs in two parts, so that they can be easily detached and repaired."

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94. For a *Floom Gate;* Harvey Frink, Hanover, Chautauque county, New York, February 25.

We have read the description of the floom gate which forms the subject of this patent, but the drawing has been mislaid; the former without the latter, would not be clear, and we shall not, at present, therefore, venture any opinion respecting the affair.

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95. For an *Instrument for determining the variation of the needle, the true meridian, and the apparent time;* William A. Burt, Mount Vernon, Macomb county, Michigan, February 25.

The graduated arcs of circles, and the other appendages used, must be placed upon a circumferentor, or other analagous instrument, furnished with a level. The particular construction of the parts might be made known by verbal description, did we think proper to give the necessary space and time, but these we cannot now afford. There is nothing in the principle which would be new to the scientific observer; the only novelty being the particular arrangement of its parts.

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96. For *Saw Mill Dogs;* Martin Rich, Caroline, Tompkins county, New York. First patented, March 6th, 1834. Surrendered and re-issued February 25.

This patent was originally noticed under its proper date, since which it has been discovered that the claim made was too broad, and it is now limited to what appears to be new in the invention.

97. For *Saw Mill Dogs;* Phineas Bennet, Hector, Tompkins county, New York. First patented December 2d, 1834. Patent surrendered and re-issued February 25.

The observations upon the preceding patent apply to this also; they are now both owned by the same individual, and parts of the two are combined in practice. The owner of them, by assignment, is Chas. E. Handy, Esq., Ithaca, New York.

98. For an improvement in *Fire Arms;* Samuel Colt, Hartford, Hartford county, Connecticut, February 25.

This appears to be a very ingenious application of the revolving breech, to pistols, and other fire arms. The description is of considerable length, and refers throughout to numerous figures which are necessary to the understanding of the particular construction and arrangement of the parts. The claim, alone, would not afford any correct ideas respecting them.

99. For an improvement in the *Boot Tree;* Mathew Mathews, Wayne county, Ohio, February 25.

The members of the craft if they feel an interest in the peculiarities of this last of the boot trees, must apply at the patent office for a copy of the specification and drawing, the latter being necessary to the understanding of the former.

100. For a *House Warmer;* O. Kindrick, and W. Elwell, Gardiner, Maine, February 25.

A hollow box of iron is placed across the back of the fire place, with a tube from one end of it leading into a cellar, or other place, for a supply of cold air, the other end being furnished with a tube to conduct the heated air into the room; this latter tube is to pass to some distance up the chimney, where it is to be elbowed, so as to admit the heated air into the room; and the patentees say, "what we specifically claim as our improvement, and for which we ask an exclusive right, is the making of, and applying a box, cistern, or cockle, as above described, to a common fire place, fire frame, or stove, for the purpose of heating, or warming, rooms."

This plan is equally old, and inefficient. Would it not be well to add a dog wheel, or some other motive power, to force air through the tube by means of a blowing apparatus?

Progress of Physical Science.

Formation of Æther. By M. Mitscherlich.

The decomposition of alcohol into æther and water is not interesting merely by the production of æther, but is especially so as an example of a particular kind of decomposition, which cannot be so well followed with any other substance, and which is manifested in the formation of some important products, for example, in that of alcohol itself. M. Mitscherlich has endeavored to elucidate the phœnomena of this decomposition by the following

experiments: Take a mixture of 100 parts of sulphuric acid, 20 of water, and 50 of anhydrous alcohol, and heat it gradually until its boiling-point becomes 284° Fahrenheit. Alcohol is then allowed to fall gradually into the vessel which contains the mixture, and the current is to be so regulated that the heat of the mixture remains constantly at 284°. If, for example, the operation be conducted with a mixture of six ounces of sulphuric acid, one ounce and one-fifth of water, and three of alcohol, and if the density of each two ounces of product as it is obtained be taken, it will be observed that this density passes gradually from 0.780 to 0.788 and 0.798, and afterwards remains constantly at the last mentioned density, which is exactly that of the alcohol employed.

If the operation be properly conducted, an unlimited quantity of alcohol may be converted into æther, provided that the sulphuric acid does not change. The distilled liquor is formed of two distinct fluids; the upper one is æther, containing a little water and alcohol; the lower one is water with a little alcohol and æther. Its weight is nearly equal to that of the alcohol employed, and it is composed of

Æther, ...	65
Alcohol, ...	18
Water, ...	17—100

If into six ounces of concentrated sulphuric acid six ounces of pure alcohol are suffered to flow gradually, a product of constant density is not obtained until the sulphuric acid has taken its proportion of water. Take, on the contrary, three ounces of sulphuric acid and two ounces of water, and let alcohol be added, drop by drop; the first two ounces distilled are merely spirit of wine, of specific gravity 0.926, containing scarcely a trace of æther. The density decreases until the quantity of water of the sulphuric acid is reduced to its proportion, and the product of the distillation has acquired the density of the alcohol. If concentrated sulphuric acid be added to anhydrous alcohol in excess, pure alcohol distils at first; but when the temperature reaches nearly 260° the first traces of æther begin to appear; the production of æther is at its maximum between 284° and 302°.

It results from the preceding observations, that alcohol when in contact with sulphuric acid, is converted into æther and water at a temperature of about 284°. A great number of analagous decompositions and combinations are known which may be attributed entirely to the influence of the contact of bodies. The most remarkable example of this kind is that of the conversion of oxygenated water into water and oxygen, by the slightest trace of the peroxide of manganese and some other substances. The decomposition of sugar into alcohol and carbonic acid, the oxydizement of alcohol when it is changed into vinegar, are phœnomena of the same kind; and so also is the conversion of starch into sugar by means of sulphuric acid. M. Mitscherlich, observing that in the preparation of carburetted hydrogen by means of sulphuric acid and alcohol, water is formed at the same time, attributes this decomposition of alcohol to the influence of mere contact, and not to the affinity of sulphuric acid for water.

Journal de Pharmacie, Juin, 1835, & Lond. and Edin. Philos. Jour.

"Report of Magnetic experiments tried on board an Iron Steam-Vessel, by order of the Right Hon. the Lords Commissioners of the Admiralty." By Edward J. Johnson, Esq., Commander, R. N., accompanied by plans of the vessel, and tables showing the horizontal deflection of the Magnetic needle at different positions on board, together with the dip and magnetic

intensity observed at those positions, and compared with that obtained on shore with the same instruments.

This report commences with a description of the iron steam-vessel, the "Garryowen," belonging to the city of Dublin Steam Packet Company, and built by the Messrs. Laird, of Liverpool. She is constructed of malleable iron, is 281 tons burthen, and draws only $5\frac{3}{4}$ feet water, although the weight of iron in the hull, machinery, &c. is 180 tons.

The experiments having been interrupted by a continuance of wet and stormy weather, the author proceeds to draw the following general practical conclusions, deduced from the series of observations already made, and points out the further experiments which he considers necessary to be tried.

1st. The ordinary place for a steering-compass on board ship is not a proper position for it in an iron steam-vessel.

2nd. The binnacle-compass in its usual place on board the Garryowen is too much in error to be depended upon.

3rd. In selecting a proper position for a steering-compass on board iron steam-vessels, attention should be paid to its being placed, as far as is practicable, not only above the general mass of iron, but also above any smaller portions of iron that may be in its vicinity; or such portions of iron should be removed altogether.

4th. The steering-compass should never be placed on a level with the ends either of horizontal or perpendicular bars of iron.

5th. The extreme ends of an iron vessel are unfavorable positions, in consequence of the magnetic influences exerted in those situations. The centre of the vessel is also very objectionable, owing to the connecting rods, shafts, and other parts of the machinery belonging to the steam-engine and wheels, which are in continual motion; independently of the influence exerted by the great iron tunnel in this part of the ship.

6th. No favorable results were obtained by placing the compass either below the deck, or on a stage over the stern.

7th. It was found that at a position of $20\frac{1}{2}$ feet above the quarter-deck, and at another $13\frac{1}{4}$ feet above the level, and about one-seventh the length of the vessel from the stern, the deflections of the horizontal needle were less than those which have been observed in some of His Majesty's ships.

The author proceeds to point out various methods of determining, by means of a more extended inquiry, whether the position above indicated, or one nearer to the deck, is that at which the steering-compass would be most advantageously placed.

The concluding section contains an account of some observations made by the author on the effects of local attraction on board different steam-boats, from which it appears that the influence of this cause of deviation is more considerable than has been generally imagined; and he points out several precautions which should be observed in placing compasses on board such vessels. Proceedings Roy. Soc. Lond. and Edin. Philos. Mag.

Hydraulic Lime. M. Vicat communicated a paper to the Royal Academy of Sciences at Paris, on the sole efficacy of magnesia in rendering certain limestones hydraulic. This paper has for its object the correction of an opinion given by M. Berthier in the Journal des Mines of 1832, that magnesia alone has no more efficacy than alumina to render lime hydraulic; from which it would follow that silex was the only essential principle in all cases.

M. Vicat was for a long time of the same opinion, which he now declares incorrect; and says that magnesia alone, when in sufficient quantity, will

render pure lime hydraulic. He does not explain the degree of energy of these new species of lime, but only affirms that they will solidify from the 6th to the 8th day, and continue to harden in the same manner as ordinary hydraulic lime.

Until his experiments are further advanced, he states that the proportions of magnesia taken and weighed after calcination, should be from 30 to 40 for every 40 of pure anhydrous lime. The native limestones examined and cited by M. Berthier contained only from 20 to 26 of magnesia for every 78 to 60 of lime: it is probable that this want of proper proportions was the cause of his negative results. M. Vicat, in conclusion, points out the importance of these observations,—hydraulic lime never having been found in the calcareous formation below the lias, is because the dolomites have never been examined, but it is now probable it may be found in this lower formation. L'Institut, No. 153., and Lond. and Ed. Phil. Mag.

Liquefaction of Sulphuretted Hydrogen. Mr. Kemp discovered a very beautiful process for the liquefaction of sulphuretted hydrogen: he found that if dry persulphuretted hydrogen be introduced into a liquefying-tube, it slowly resolves itself into liquid protosulphuretted hydrogen, whilst sulphur in crystals is deposited. If previously there has been introduced into the end of the tube iodine in a dry state, then the protosulphuretted hydrogen, when it comes over upon it, dissolves it rapidly, and a dark yellowish brown coloured liquid results. If now to this there be added the least possible proportion of water (which is accomplished by a peculiar bend in the tube), instant reaction takes place, sulphur is deposited, and hydriodic acid in a most condensed and liquid state results. It is only necessary that a trace of water be present to commence the decomposition of the former brown compound, which I suppose to be the hydrosulphuret of iodine; for when this once commences, it goes on to any extent, and the liquid hydriodic acid formed may be called almost anhydrous. It boils by the heat of the hand like other condensed gases; it is of a yellowish colour, and resembles somewhat liquefied chlorine. Lond. and Edin. Philos. Mag.

Experimental Researches in the laws of the motion of Floating Bodies. By J. S. Russell. It was the object of these inquiries to assist in bringing to perfection the theory of Hydrodynamics, and ascertain the causes of certain *anomalous facts* in the resistance of fluids, so as to reduce them under the dominion of known laws.

The resistance of fluids to the motion of floating vessels is found in practice to differ widely from theory, being, in certain cases, double or triple of what theory gives, and in other and higher velocities, much less. These deviations have now been ascertained to follow two simple and very beautiful *laws:* 1st. A law giving a certain *emersion* of the body from the fluid as a function of the velocity. 2nd. A law giving the resistance of a fluid as a function of the velocity and magnitude of a wave propagated through the fluid, according to the law of Lagrange. These two laws comprehend the anomalous facts, and lead to the following results:

1. That the resistance of a fluid to the motion of a floating body will rapidly increase as the velocity of the body rises towards the velocity of the wave, and will become greatest when they approach nearest to equality.

2. That when the velocity of the body is rendered greater than that due to the *wave*, the motion to the body is greatly facilitated: it remains poised on the summit of the wave in a position which may be one of stable equilibrium; and this effect is such that at a velocity of nine miles an hour the resistance is less than at a velocity of six miles behind the wave.

3. The velocity of the wave is independent of the *breadth* of the fluid and varies with the square root of the *depth.*

4. It is established that there is in every navigable stream a certain velocity at which it will be more easy to *ascend* the river against the current than to *descend* with the current. Thus, if the current flow at the rate of one mile an hour in a stream four feet deep, it will be easier to *ascend* with a velocity of eight miles an hour on the wave, than to *descend* with the same velocity behind the wave.

5. That vessels may be propelled on the summit of waves at the rate of between 20 and 30 miles an hour. Trans. Brit. Assoc. & Lond. and Edin. Philos. Mag.

Communication of Vibrations through soil. By Capt. Denham. Capt. Denham ascertained that the vibrating effects of a passing laden rail road train in the open air extended laterally on the same level 1110 feet, (the substratum of the positions being the same,) whilst the vibration was quite exhausted at 100 feet when tested vertically from a tunnel.

The tunnel was through a stratum of sandstone rock: the rails laid in the open air on a substratum of 12 feet of marsh over sandstone rock. The method of testing was by mercury reflecting objects to a sextant. The experiments were made in the neighborhood of Liverpool.

Trans. Brit. Assoc., Lond. and Ed. Philos. Mag.

Progress of Practical and Theoretical Mechanics and Chemistry.

Cutting Veneers. Veneers used to be cut by the hand-saw; at present, the circular saw is, I believe, universally employed in England for this purpose, with the advantage not only of cheapness and expedition, but of a smaller waste of wood in saw dust, and of greater accuracy and precision in the thickness of the veneer—a quality essentially requisite to produce good work in the finished article.

In a large veneer-mill which I had an opportunity, through the kindness of one of our members, of visiting, there are five circular saws. Each consists of a strong, stiff, circular frame-work, of the shape of a plano-convex lens, or rather a low hollow cone, tapering gradually to the edge, from which projects a ring of soft steel a few inches broad, pierced with many holes. The saw is a plate, or rather a flat ring, of well-tempered steel, about twelve inches broad, pierced with as many holes as the former ring, and firmly secured to it by means of screws: a band over the axis of the saw communicates motion to it, by connecting it with the first mover, which is a steam engine. The wood to be cut is laid on the cross-bars of a frame, which are previously covered with glue, and remains in a horizontal position, loaded with heavy weights, till the glue has become dry. The frame, with the log, or *flitch*, as it is technically called, adhering to it, is then fixed sideways in a carriage which traverses backwards and forwards, the frame itself being likewise capable of motion at right angles to the run of the carriage, in order to project the log sufficiently to bring it within the action of the saw. The quantity of the latter motion is regulated by a screw, one turn of which throws forward the frame, and, consequently, the log, about $\frac{1}{50}$ of an inch. The saw being put in motion, the workman first turns the regulating screw more or less, according to the required thickness of the veneer; he then, by pulling a lever, throws the apparatus into gear, which gives motion to the carriage, and takes his seat by the inner, or con-

vex, side of the saw. As soon as the log comes up to the saw, he directs the head of the veneer into a curved frame, which it readily enters, on account of its flexibility, being so very thin, and then employs himself in holding in each hand a chip of wood obliquely against the teeth of the screw, in order to clear them of the particles of saw dust which otherwise would more or less clog up. In a minute or two the log has passed the saw, the motion of the carriage is reversed, and it is brought back to the point from which it first started. Being then thrown out of gear, the regulating screw is again turned, to project the log as much as the intended thickness of the next veneer; and then all those motions are repeated which I have already described. The usual thickness of a veneer is about $\frac{1}{12}$ of an inch; but some kinds of wood may be cut as thin as about $\frac{1}{16}$ of an inch. About half the wood is converted into saw dust.

Of the fine saws employed at these mills, the largest is eighteen feet in diameter, and makes thirty revolutions in a minute. Three are each ten feet in diameter, with a speed of about sixty revolutions in a minute; the small saw is six feet in diameter, with a speed of eighty revolutions in a minute, which is sometimes increased to one hundred, or even one hundred and twenty revolutions. The teeth of the saws are nearly a quarter of an inch deep. A saw lasts about a year; for the first six months it is employed in coarse work, and afterwards, till worn out, in fine work.

The veneer is necessarily split, for an inch or two at its head, in getting it on the curved frame; and as it is likewise liable to split in drying, a thin strip of linen is glued along the two cross edges of each veneer, which prevents this accident: the holes, at least those of an inch or more across, are also covered in the same manner.

The general method of laying down veneers is very simple, although to do this well and correctly, requires, as every thing else does, practice, attention, and patience. The under side of the veneer, if previously smooth, must be scored by means of a toothing-plane; but if cut by a circular saw, it generally acquires a sufficient tooth by that operation. The surface to be veneered is covered over with strong glue, and before it chills or gelatinizes, the veneer, previously prepared and cut to the shape required, is laid down upon it, care being takèn in doing so, to enclose as little air as possible. When it has been pressed down to its proper bearing in every part, the compound piece is enclosed between two hot boards, secured at the edges by thumb screws, or, which is still better, is put into a press between two hot plates, where it remains till perfectly dry.

The next process is to give a smooth surface to the veneer, which is effected by first filling up any holes by plugs of the same kind of wood cut to fit them, or by making a paste of fine saw dust and glue, and pressing it into the holes by hand, and then by the successive use of small planes, scrapers, files, glass-paper, Dutch rushes, and fish skin. Lastly, a varnish is added, which has the effect of bringing up the colour and lustre of the wood, and protecting it from the action of the air. If the colour of the wood is itself unexceptionable, the varnish should be as colourless as possible; but if a little mellowness or warmth is required, a varnish coloured accordingly must be applied. The so called, French varnish, has within the last few years almost entirely superseded the oil varnishes, as being more quickly applied, possessing more lustre and hardness, being less liable to be injured by any common liquid spilled upon it, and not requiring to be renewed or refreshed except at long intervals. It is made by dissolving lac in spirits of wine, and then shaking it up with olive-oil to the consistence

of an emulsion, in which state it must be used. It is fixed on the surface of the wood by means of a linen rubber, applied with a circular or spiral motion. Varley in Trans. Lond. Society Arts.

Lighting and Ventilation. Questions proposed by the Committee of the Athenæum to Mr. Faraday, on Lighting and Ventilation, with the answers. Originally printed February 14th, 1831.

[We re-print the present article, by permission, from a document which has been circulated among the members of the Athenæum.]

Q. What is the ratio of light of an oil and gas burner?

A. In an experiment made at the Athenæum, with an excellent Argand oil lamp, regulated by Mr. Hancock, and compared with a 15-hole gas burner, the light of the gas was to that of the oil as 21 to 13.

Q. What is the ratio of heat?

A. In experiments made to determine the heat evolved for *equal quantity of light* from oil and gas burning brightly from Argand burners, the heat from the oil being 2, that from the gas was nearly 3.

Q. Is either sulphurous or sulphuric acid formed by the combustion of coal gas in the ordinary way?

A. A little sulphurous or sulphuric acid is generally formed from the combustion of coal gas. If well purified gas be used, this product is rarely sensible: it is less sensible as sulphuric than as sulphurous acid. Upon closely questioning persons who have declared that they smelt sulphur from gas, I have usually found they meant something else—generally the oppressive heat, or the dry sensation, or the smell of a little gas unburnt, none of which have any thing to do with the sulphur-product from gas.

Q. From a gas light, properly regulated, is gas respired?

A. I do not believe that any gas escapes unburnt from a gas light well regulated. It is far more likely that oil vapour should escape unconsumed from an oil burner, than gas from a gas burner.

Q. Will an oil or gas light soonest soil the ceiling of a room?

A. Neither oil nor gas ought to soil, or will soil, the ceiling of a room, if well regulated. Either will do so when badly regulated. I think of the two, oil is most likely to do so; because of the changes which take place in the wick, in the temperature of the oil, &c., during burning, and which do not occur with a gas lamp properly regulated by a governor.

Q. What effect will the heat evolved have on the temperature of a room?

A. This effect depends upon so many circumstances, as the size and tightness of the room, the proportion of light, &c. &c., that it can only be deduced from a series of observations.

Q. What are the comparative effects of oil and gas lights on the quality of the air, light for light?

A. It is exceedingly difficult to ascertain, and if ascertained, to describe correctly the effects of lights on air so as to convey a just opinion of their influence; thus, with regard to their greatest effect, which is the power of heating, it is of advantage and desirable up to a certain point, and above that point is unpleasant and disagreeable: but that point depends upon many other things as well as the lights, and, what is still more important, differs for different persons, so that it becomes in that respect impossible to please all. Gas light will heat air faster than oil light; it therefore at first does good quicker, and afterwards does harm quicker, than oil. As to the proportionate deterioration of air by the oxygen abstracted, I think it probable that gas would, *light for light*, have the greatest effect; but I do not believe that effect would be sensible in either case. As to the deterioration of air

by the sulphurous acid and unburnt gas thrown into the room, I think little of it in the present case. I think that to be rather a popular error, caused by persons ascribing effects which they feel but cannot discriminate, to the first single cause which occurs to them, thinking of quality only and forgetting quantity.

Q. What are the comparative qualities of the light from oil and gas?

A. When the oil was burning in its best manner, still it gave a much yellower flame than the gas; the whiteness of the gas flame is a necessary consequence of its higher temperature.

Q. Taking all the circumstances into consideration, what, in your opinion, is the cause of the oppressive feeling complained of in certain rooms in the Athenæum?

A. In my opinion the principal cause of complaint is of the following nature: A house has been built, and every endeavor made to render floors, ceilings, windows, walls, and doors, tight and close; the rooms in it are well warmed during the day, and, having been brought to such a temperature and state that the first person who enters is fully satisfied; from fifty to two hundred persons are introduced, evolving both heat and effluvia; a number of powerful burners are put into and continue in action; and when the injurious agency of these causes has continued for one, two, or three hours, complaints are made that the heat is oppressive, or the odour unpleasant. Things are arranged so as to produce a perfect effect under one set of cercumstances, and then, changing the circumstances, the effect is expected to remain the same, though it must of necessity be different. The large room and the library are made quite warm enough by daylight, when there are only a few persons there: then they are lighted, many persons enter, and they must of course very soon expect an oppressive sensation. I have no hesitation in believing that the cause of these complaints might be removed by extending and adjusting the system of ventilation in those rooms.

Q. Why has oil been displaced by gas in the public rooms of the Royal Institution?

A. Oil has been displaced by oil gas, in the first place, because of the economy of the latter; then because of its superior cleanliness, and its facile management. Much harm was done to our seats in the lecture-room during the use of oil lamps. We still burn oil in table-lamps in our library, on other evenings than the Fridays, because we require less light on those occasions.

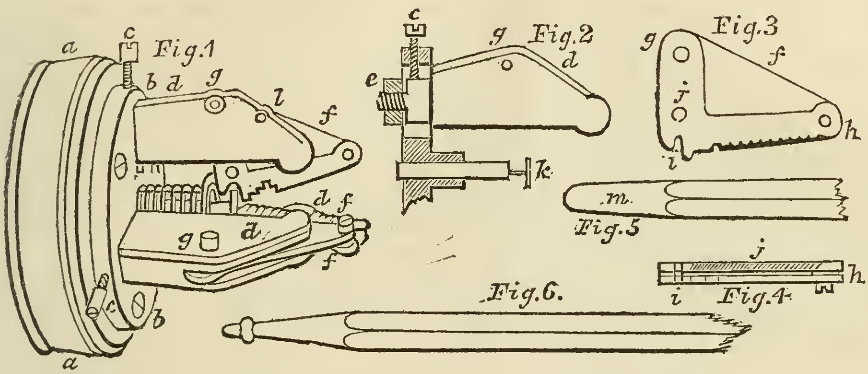
Athenæum, London, 26th April, 1836. Rep. Pat. Invent.

Franklin's machine for making Tips for Umbrellas. The ribs or stretchers of umbrellas are terminated below in balls or some other ornament which are *tips.* These tips are sometimes of bone or of metal, and sometimes the ribs are *self-tipped;* that is, the tip is made by rounding the end of the whalebone itself into the required figure. Considerable difficulty has been experienced in making these tips with sufficient precision, as they must of course be made in some cheap and expeditious manner. The usual method was by rough-filing them into shape, and then giving the requisite degree of smoothness by means of glass-paper. Mr. Franklin, perceiving the tediousness of this mode, and yet knowing that whalebone, from its fibrous and elastic structure, requires to be brought into shape rather by filing and scraping than turning, which would be liable to tear up the fibres, has devised a tool possessing the properties of the file and scraper combined, and at the same time working with great speed.

Mr. Franklin obviates the necessity of fixing the whalebone in the chuck,

by holding it in a hand-vice and presenting it between three compound cutters that project from the face of a chuck, and revolve with the full speed of the lathe, by which the determined form is almost instantaneously given to it.

In fig. 1 *a a* is the chuck which screws on to the nose of a mandril: it has a seat turned in it to receive the circular plate *b b*, and a cavity deep enough for screw-nuts at the back of the plate. In this plate are three radial openings with adjusting-screws *c c* at their ends, in which are fitted the three forked frames *d d d*, which are fixed by screw-nuts, one of which



e is shown in fig. 2. These frames hold the compound cutters *f f f* by the screws at *g g*, on which they turn as joints. Fig. 3, shows a side view of one pair of cutters, and fig. 4, a front view of their cutting edges. They are made of thin steel: the triangular plate *f* is filed along the edge *h i* to the exact form of the tip, and is set to a sharp cutting edge; on this is placed the second plate *j*, having collets interposed to keep them a little asunder, as shown in fig. 4. This plate is at first formed so as to correspond perfectly with the under one; it is then filed into a waved edge, almost as if making a saw: these small notches are inclined, as shown in fig. 4, in order to make their cutting edges meet the whalebone. The three pairs of these cutters are made exactly alike, and the holes *g*, by which they are jointed in the frames *d*, are also quite alike. The cutters so prepared are put into their frames *d*, and these are slightly bound in their places by the nuts *e*; they are then placed exactly at equal distances from the centre by the adjusting-screws *c c*, and then the nuts *e* are bound quite fast to fix them. It is requisite for these cutters of themselves to keep open enough to receive the whalebone; and it is also requisite for them to close exactly alike on the whalebone when the workman presses it in. To press them outwards or open, a spiral spring is placed on a neck projecting from the centre of the plate *b b*; and to make them open or close equally together, a poppet *k* slides in the central neck, as shown in fig. 2: this has a thin circular head *k*, and the cutters have exactly similar notches as at *i*, fig. 3, into which this head enters, and thereby causes them to move simultaneously. The cutters would fly outwards, poppet and all, if there were not a stop; but, as they can only move together, a stop to one cutter is enough—the screw *l*, fig. 1, is that stop: the back of the cutter *f* comes against it when they are all open enough. *m*, fig. 5, represents the end of a whalebone previously rounded, ready to be thrust in between the cutters described, whilst they are in rapid rotation: the waved cutters come first in contact with the whalebone, and cut through the fibres without tearing them up; the clear

cutters follow, and scrape off the ridges as fast as they are made by the waved cutters. This operation, being thus divided between two cutters, prevents the breaking up of the fibre. Fig. 6, shows the form given to the tip by these cutters. The cutters are never stopped to change the whalebone, but are kept constantly revolving, and the tips are formed almost as fast as the workman can press them in and take them out. Experience soon teaches him to give the pressure at which the cutters will act best on the material, which comes from this tool smooth enough to be varnished, or to be polished with oil and charcoal dust on leather. For this purpose the whalebone is turned quickly round with one hand, being at the same time supported on the thigh, whilst the other holds the leather round the tip to polish it.

Trans. Lond. Soc. Arts.

Howlett's Crayons for Drawing on Glass. Mr. Howlett's perspective tracing-glass consists of a plate of clear glass fixed in a frame, and set upright on a tripod stand, so as to bring it on a level with the eye of the artist. From the top of the tripod projects horizontally a light frame, with a hole at the end, for the purpose of supporting in a vertical position a pin, at the top of which is a small perforation, through which the artist looks while he traces on the glass the objects seen through it.

So far the instrument does not differ in any material respect from those usually employed for this purpose. But as the glass is not capable of receiving the traces made by the pencil, it is necessary to cover the surface of the glass with some substance, at the same time as transparent as possible, and capable of being marked by a pencil. These conditions, however, have not hitherto been found to be reconcilable: the most transparent paper that can be made is not capable of allowing distant objects to be seen through it with sufficient distinctness, and glass itself, though unexceptionable with regard to tranparency, will not retain traces from a black lead pencil, or from any other of the materials usually employed in sketching.

The way in which Mr. Howlett has solved this problem, is by the invention of crayons capable of bearing a fine point, and of leaving traces on the surface of glass. In the use, therefore, of this instrument, the objects are delineated with the crayon on the surface of the glass, and afterwards a piece of paper is laid over the drawing, and is secured by its four corners to prevent it from slipping; the glass with the attached paper is then held up to the light, and the objects already drawn on the glass are traced on the paper with a common pencil. If the paper, instead of being laid on the drawing, is placed on the opposite surface of the glass, the copy will be made in a reversed position, and is thus immediately adapted to the use of the engraver: or the tracing on the glass may be transferred to the paper, by laying the paper over the tracing, and rubbing them together with an ivory handled knife.

If the tracing-paper employed is thick or opaque, so that the lines on the glass are only seen indistinctly through it, a great degree of blackness may be given to them, by dusting the surface of the glass over with dry lamp-black, and then rubbing it off with a soft camel-hair brush, very lightly applied; the traces made by the crayon being somewhat adhesive, the lamp-black will be fixed on them by the action of the brush, while it is swept off from the rest of the surface.

The crayons are made of three degrees of hardness, to suit any climate, and are not acted on by water, either fresh or salt. Asphaltum and yellow bees-wax, in equal proportions, are melted together, and then lamp-black, just sufficient to give it colour, stirred in; the mixture is then cast into

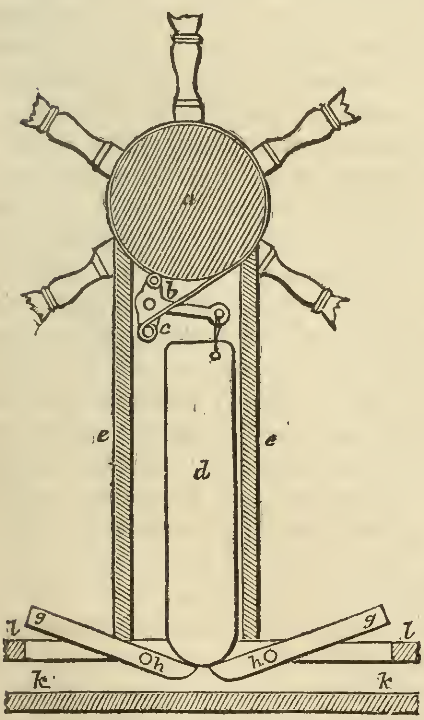
sticks, and forms a crayon suitable for a temperate degree of heat; but, for very hot weather, the hardest kind of heelball, lowered with a little tallow, answers admirably.

The glass plate, previous to drawing it, should be rubbed well with a leather, in order to free it from moisture or dirt, and the artist, while making the drawing, should wear a finger-stall.

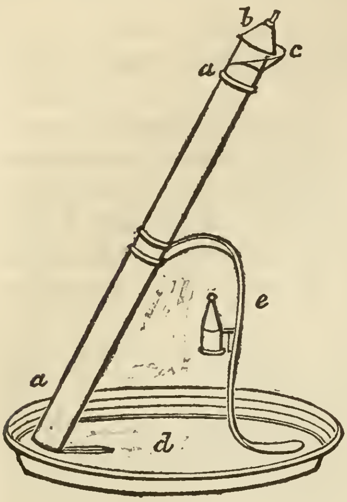
It is sometimes difficult to bring the crayon to a fine point with a common penknife; for if the edge of this latter is set to the shape of a very fine wedge, it will slip through the crayon, as, on the other hand, a blunt wedge will break off the point before it has been cut sufficiently fine; but if the knife is set chisel-shaped, the oblique surface being applied next to the crayon, shavings of extreme tenuity may be taken off, and a very fine point will be the result. Trans. Soc. Arts, Lond.

Pearce's Stopping for a Steering-Wheel. The pressure of the sea on the rudder is sometimes so strong, as to overpower the man or men at the steering-wheel; the consequence is, that the men are knocked down, and often seriously hurt, and the safety of the ship itself may be endangered by the rudder suddenly flying round. Mr. Pearce has done for the steering-wheel what has long ago been done for the crane and other similiar machines; that is, he has attached a brake to it, capable, by its friction, of so far controlling the pressure of the rudder, as to enable the helmsman to retain the command of it.

The annexed figure presents a section immediately behind the wheel, and before its post, the spectator looking a head. The axis of the wheel *a* is nearly surrounded by a copper band, the extremities of which, *b* and *c*, are attached to the short arms of a T-shaped lever turning on a centre between *b* and *c*, and from the longer arm of which is suspended the leaden weight *d*. The end *c* of the copper band is split, and its halves pass on each side of the T-shaped lever. The whole of this apparatus is contained in a case formed in front of the post, the sides of the case *e e* being shown in section. It will be seen that the effect of the weight *d*, acting through the instrumentality of the T-shaped lever, is to tighten the copper band round the axis of the wheel, and thus, if not to supersede, at least very much to relieve, the labour of the steersman in holding the wheel during rough weather. When any alteration in the ship's course is required, the wheel may be set free by pressing the foot on either of the levers *g g*, which turn on the centres *h h*, raise the weight *d*, and thus relieve its pressure on the copper band. The levers *g g*, may, when required, be kept permanently down, in which case they form a part of the small floor or platform *l l*, raised a few inches above the surface of the deck *k k*. Ibid.



Higgins Oblique Candlestick. In the annexed figure *a a* is the tube which contains the candle, resting on the spiral spring: it is about fourteen



inches long, rather more than an inch in diameter, and is inclined about thirty degrees from a vertical line. The cap or nozzle *a b* slips on with a bayonet joint, and has a hole at the end about five-eighths of an inch in diameter, through which the wick protrudes. A small lip *c* projects from the nozzle, to catch any trifling overflow of tallow which may possibly happen when the candle is first lighted. The base of the candlestick *d*, and the curved support *e* to which the extinguisher is attached, do not require description. It is obvious that the spiral spring must be of such a length as to keep the candle close up to the cap *b* till it it entirely consumed.

From several experiments it appears that a candle placed in this stick is burned more perfectly, and with less waste and guttering, the more it is blown about by the wind, provided the draft is not so violent as to extinguish it. Ibid.

Indian Sword-Blades. The thanks of the Society were voted to Capt. Bagnold, R. N., of Blackheath Villa, Saxmundham, for the following account of the manufacture and tempering of Sword Blades in the province of Cutch, from information communicated to him by his brother, Lieut. Colonel Bagnold, late President of the Regency in Cutch. These swords are celebrated throughout India for their peculiar strength and edge, and are thus made:—An inch bar of fine Swedish or English steel is forged out into plates seven inches long, one inch broad, and one-sixth of a inch thick. Similar bars of fine, soft iron are prepared in the same manner. These are smeared with a paste of borax dissolved in water, and laid in piles of twelve—nine of steel to three of iron, or three to one alternately: each pile is wrapped round with a rag thickly plastered with mud made of a loamy earth; then heated, welded, and drawn out to a bar one inch and one-eighth broad, and one-third of an inch thick: this is bent zig-zag three or four times; is again welded and drawn out to half an inch thick; and, during the heat, borax is frequently dropped on the metal while in the fire. Two of these bars are next welded into one, and when about twelve or fourteen inches long, it is bent into the form of a loop or staple; in the middle of this a piece of fine-grained file is inserted, of the same width, and nearly as thick: all is then welded together, and the blade is formed.

Tempering.

An earthen pot twelve inches wide and six deep, is notched on the edges (the notches being opposite each other), with a file about a quarter of an inch deep, is then filled nearly up to the notches with water, and oil is then poured on the surface. The blade, being heated equally to a light red, is removed from the fire, and the point, entered into the notch on the edge, is passed to the opposite one, keeping the edge from a quarter to half an inch in the oil: it is drawn backwards and forwards rather slowly till the hissing ceases and the rest of the blade above the fluid has become black; a jug of water without oil is then poured along the blade from heel to point. In order to take out the warp produced by tempering, the blade, when nearly cold, is

passed over the fire three or four times; then being brought to the anvil, is set straight by striking it regularly, but moderately, with a hammer; by this means the Damascus-curved blade may be brought nearly straight. Blades made in this way in my brother's presence, when he was President of the regency in Cutch, were proved, previous to grinding, by striking at stones, ram-rods, musket barrels, and even wheel-tires, without injury to the edge. Ibid.

Silk Worms. To meet the objections on the score of climate, I would suggest, first, that we ought to breed silk worms in hot-houses throughout the year; and, secondly, that the Pavonia Moths of Europe and other countries, as well as Atlas Moths of Asia, should be reared in like manner. It has already been remarked, that several crops are obtained in the east within the year; and why may we not also expect in England several, by means of breeding the worms in hot-houses. In India the longest period for a generation of silk worms appears to be forty days: even allowing fifty days in England for a generation, we may then expect seven crops of silk. If we only obtain four, that is double the number produced in Italy, where they annually rear but two. I need now scarcely add that four crops will repay the speculator for rearing silk. To reduce, however, the expenditure as much as possible, I would recommend him to feed the silk worms with lettuce instead of mulberry leaves; first, as there is less expense in the cultivation; secondly, as the lettuce can be grown cheaply in cucumber frames during the winter months; and, lastly, as the quality of the silk does not depend so much on the *quality* of the *leaf* as it does on the *degree* of temperature in which the worm is reared, I would strenuously recommend the lettuce. Should the food of the mulberry tree, however, be preferred to the lettuce, we can still adopt the discovery of Ludovico Bellarde, of Turin. His plan consisted in giving the worms the pulverized leaves of the mulbery trees slightly moistened with water: the leaves were gathered in the previous summer, dried in the sun, reduced to powder, and then stowed away in jars for the winter food, or till the tree was in full foliage. Repeated experiments made by Bellarde prove that the worm preferred this kind of food to any other, as they devour it with the greatest avidity. To reduce still further the expenditure, old men, women, and children might be employed in feeding the worms, as is the case at present in India: indeed, might not the poor in the work-houses be rendered available, thus affording them amusement and profit? Ibid.

Dr. Church's Steam-Coach. We have much pleasure in stating that Dr. Church has at length completely and satisfactorily accomplished the construction of a steam carriage, in every way suited to run on ordinary roads.

The external appearance of the carriage is made exactly to resemble a stage-coach, and is about the same dimensions. It consists of a frame work with a casing enclosing the boiler and engines; the furnace, fuel-box, water chamber, and condenser, all of which hang upon springs, supported by the running wheels, require no auxiliary tender.

The casing is formed and painted like an ordinary stage-coach, the conductor sits, for the purpose of steering, in the place of a coachman, on the box in front; the engineer who attends the fire and the machinery, and has command of the steam, stands also in front, in an open compartment, below the conductor.

There are seats for the persons on the roof before and behind, as in other stage-coaches; but as this carriage is intended merely to be the loco-

motive engine for impelling a train of carriages connected to it, the seats upon this are to be considered as of an inferior class.

Some of the most important features of the locomotive carriage as now completed, viz. the peculiar construction of the boiler and arrangement of the working parts of the machinery, form portions of the subject of a patent granted to Dr. Church, on the 16th March, 1835; the specification of which, embracing other matters, is too elaborate for insertion in our present number, but will most probably appear in our next.

As several partially successful, but, in our opinion, very unsatisfactory attempts have been made by other persons, to impel carriages on ordinary roads by steam power, we consider it necessary to point out some of the peculiarities in Dr. Church's present carriage, which we consider to be its striking features of advantages.—Firstly, though the engines work at high pressure, the eduction steam is so effectually condensed after passing from the working cylinder, that no visible portion of it escapes into the air, but the whole is converted into water, and re-conducted into the boiler in a heated state. Secondly, the flues are so constructed and arranged, that no smoke is allowed to escape from the chimney; and the consequences of these two novel features, as regards locomove engines running on ordinary roads, are very important, viz. that neither is there any perceptible noise arising from the discharge of steam, or any offensive effluvia emitted from the combustion, so that the carriage proceeds along the road without, in the slightest degree, attracting the attention of horses which may pass it.

We have only space to say further, that the Birmingham and London Steam-carriage Company, with whom the Doctor is connected in this invention, are perfectly satisfied with the carriage as now completed; and though alterations and slight improvements may and will necessarily be adopted in the future exercise of the plans, yet they deem the present carriage to be so fully effective and satisfactory, that they have advertised for a practical engineer to superintend the erection of a sufficient number of these carriages at their works, exactly according with the model produced.

We understand it to be the intention of the company to establish three stations between London and Birmingham for their trains of carriages to halt at, and to supply a fresh locomotive engine at each station, in order that the engines, after running about twenty-six miles, may be severally examined, and such little matters as cleaning, oiling, and adjusting parts attended to: which arrangement will avoid subjecting passengers to the inconvenience of delay, and tend greatly to prevent accidents.

We have only to add, that having witnessed the manner in which this carriage performs its duty on the public road, we have no hesitation in saying that we are now satisfied that steam may be safely, and, we believe, economically, employed, in connection with Dr. Church's improved machinery, as an effective substitute for horses, in the ordinary transit of stage-coach passengers on all the turnpike roads in the kingdom.

Lond. Jour. of Arts, Aug.

Progress of Civil Engineering.

Principles of Railway Transit, as they regard the force of traction, expense, and speed. By John Herapath, Esq.

Force of Traction.

If t denote the force of traction of a ton on a level, and z the angle of inclination of any plane,

$$t \cos z \pm \sin z,$$

is obviously the force of traction in ascending or descending the plane, the plus sign being used for ascending and the minus for descending. And because in all practicable railways z is very small, which gives $\cos z = 1$, and t by experiment about $\frac{1}{240}$, the force of traction is as

$$1 \frac{+h}{-22} \text{ very nearly.....(1)}$$

in which unity is the force of traction on a level, and h the height in feet per mile of the inclined plane.

Expense of Transit.

Since this force of traction is the same for all velocities, it follows that, the load being the same, and the temperature of steam the same, the quantity of steam consumed, supposing it to follow in a column, would be the same for a given distance, whatever be the velocity; and as the distance run, that is, as the velocity, for a given time. Consequently, the expense, which I presume must be proportional to the amount of such steam so consumed, is the same for a given distance, at whatever velocity run. Therefore if l be the load, d the distance, and e the expense.

$$e \propto l \times d.$$

For two engines would be required under the same circumstances to tow a double load, three a triple load, &c.; and hence it is reasonable to infer, that the expense of the same engine exerting a double, triple, &c. force, would not sensibly differ, if at all, from the same rule. Consequently, if for l we put (1) multiplied by $a\,l$,

$$e = (1 \times \frac{h}{22})\, a\, l\, d.\ldots(2)$$

where a is a constant to be determined from experience. It is hardly fair to apply the theorem in descending planes, particularly unless the descent is less than 22 feet per mile, owing in the first instance to the waste of steam by turning it off, and in the second to the breaks being generally used to check the descending velocity.*

Now, according to the average experience on the Liverpool and Manchester Railway, the expense of transit, Mr. Dixon, the Company's intelligent engineer, informed me, is about a half-penny per ton per mile, though there are other railways, I believe, in which it does not exceed half of this sum, or a farthing per ton per mile. Hence l being the load in tons, and d the distance in miles, we have in pence,

$$e = (1 + \frac{h}{22})\frac{l\,d}{2}\ldots.(3)$$

Under any other circumstances the 2 must be changed into the divisor of a penny, which the cost of transport happens to be.

Velocity of Transit.

If we suppose a piston one-half the area of another, it must evidently travel with twice the velocity to consume the same quantity of steam at the same elasticity and temperature, and its force will, of course, be just one-half. Therefore a half load, under such a circumstance, would be driven with a double velocity. In the same way a third and a fourth of a

* If $h=22$ feet, it is obvious that $t=0$, or the friction of 240th would be in equilibrium with gravity without any assisting power. If h is greater than 22, there will be an accelerating force derived from the weight of the body, which corresponds to the negative value of t. B.

load would be driven with three or four times the velocity; and, generally, other things being alike, the velocity would be inversely as the load, the area of the piston varying as the load.

But supposing the piston and fire to remain the same, what would be the velocity of a double, triple, &c. load? This is a question which I am not aware has ever been satisfactorily answered, physically or experimentally. Indeed, on the received doctrine of airs, I do not think it admits of an answer. I shall endeavour to solve the problem physically, on the only reasonable principle I can imagine, and on laws of aeriform bodies published and constated with experiment by me fourteen years since in the Annals of Philosophy. Let it be distinctly understood, that not being quite certain of the principle alluded to, I do not offer it as a demonstrated solution; but I should be glad to see it brought to the test of experiment, and whenever it shall be, I do not expect it will be found much in error. If so, it will have the merit of bringing within the grasp of physical science one of the most important points in the action of the steam engine.

The principal referred to is this:—That the number of steam particles emitted every moment, drawn into the temperature of the steam, is always proportional to the heat simultaneously communicated by the fire to the water.

If, therefore, the heat communicated be uniform, and N denote the number of particles momentarily emitted, and T the true temperature of them,

$$N\ T \text{ is a constant quantity.}$$

But if E be the elasticity of the steam, and n the number of its particles contained in a given space,

$$E \propto n\ T^2,$$

by Prop. 8, Annals for May, 1821, p. 345. And if V be the velocity of the piston, n V is evidently as the number of particles of steam momentarily carried off or emitted. Therefore,

$n\ V \propto N$, and $T\ n\ V \propto N\ T$ a constant. Hence,

$$E \propto n\ T^2 \propto \frac{1}{TV} \times T^2 \propto \frac{T}{V} \propto \frac{\sqrt{F+448}}{V},$$

(according to Cor. 2, Prop. 1, p. 98, Annals for Aug. 1821) F being the Fahr. temperature. But E, the elasticity will be as the load or force of traction, and V as the velocity of the engine. Consequently,

$$\left(1+\frac{h}{22}\right) l\ V \propto \sqrt{F+448} \ldots\ldots (4)$$

Moreover, because when the elasticity of steam, at its proper tension, is tripled, the right hand member of the equation will increase only about 5 per cent. we may consider this member constant for all practical purposes; and hence the velocity of transit, other things alike, will be inversely as the load and force of traction.

We are now in possession of three rules of comparision, as simple and correct as, I believe, it is possible, in the present state of our knowledge, to make them.

First, the force of traction on any plane inclining with the horizon h feet per mile is,

$$9\left(1+\frac{h}{22}\right) \text{ lbs. up, or } 9\left(1+\frac{h}{22}\right) \text{lbs. down}$$

per ton, allowing the draught per ton on a level to be 9 lbs.

Secondly, the expense of transit per ton per mile is, in pence,

$$\tfrac{1}{2}\left(1+\frac{h}{22}\right) \text{ up, or } \tfrac{1}{2}\left(1-\frac{h}{22}\right) \text{ down,}$$

suppposing the steam at all times to act as the motive or retarding power.

Thirdly, the speed, if it be 30 miles per hour on a level, is

$$\frac{30}{1+\frac{\ }{22}}$$

We can hardly apply this formula to descents, unless they are very small; for if the descent was 22 feet per mile, it would make the velocity appear to be infinite in consequence of gravity doing all the work, and the object to be propelled amounting, therefore, to nothing.

For the more readily examining the capabilities and economy of any line, I have computed the subjoined table. The last column was computed by multiplying the third with 30, and as the succeeding decimals were not taken into account, it may not be quite correct in the decimal figure; but it is quite near enough for any practical purpose.

Elevation per mile in feet.	Force of Traction, in pounds per ton.	Parts of a load.	Expense per ton per mile in pence.	Velocity per hour in miles.
0	9.00	1.00	.500	30.0
2	9.82	.92	.545	27.6
4	10.64	.85	.591	25.5
6	11.45	.79	.636	23.7
8	12.27	.73	.682	21.9
10	13.09	.69	.727	20.7
12	13.91	.65	.773	19.5
14	14.73	.61	.818	18.3
16	15.55	.58	.864	17.4
18	16.36	.55	.909	16.5
20	17.18	.52	.955	15.6
22	18.00	.50	1.000	15.0
24	18.82	.48	1.045	14.4
26	19.64	.46	1.091	13.8
28	20.45	.44	1.136	13.2
30	21.27	.42	1.182	12.6
32	22.09	.41	1.227	12.3
34	22.91	.39	1.273	11.7
36	23.73	.38	1.318	11.4
38	24.55	.37	1.364	11.1
40	25.36	.35	1.409	10.5
45	27.41	.33	1.523	9.9
50	29.45	.31	1.636	9.3
55	31.50	.29	1.750	8.7
60	33.55	.27	1.862	7.1

JOHN HERAPATH.

Kensington, June, 1835.

Lond. Mech. Mag.

[Extracts from a communication to the London Mechanics' Magazine.]

Daglish's Prize Rails and Pedestals. I herewith send you drawings of my parallel rail and joint and intermediate pedestals, with the mode of fastening them to the stone blocks or sleepers, and also my method of keying the rails into their respective pedestal; for all which I obtained the premium lately offered by the London and Birmingham Railway Directors, with the exception of the mode of fastening the pedestals to the stone blocks, which the Committee of reference are said to have thought inferior to the lewis-pin of Mr. Swinburn, to whom the Directors accordingly awarded a third of the premium. I have also added sketches of certain modifications of my rail and pedestals, which it might be advisable to adopt under particular circumstances, and in some peculiar localities.

Fig. 1.

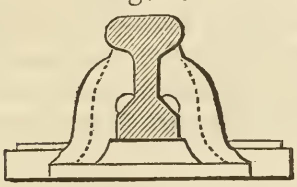


Fig. 2.

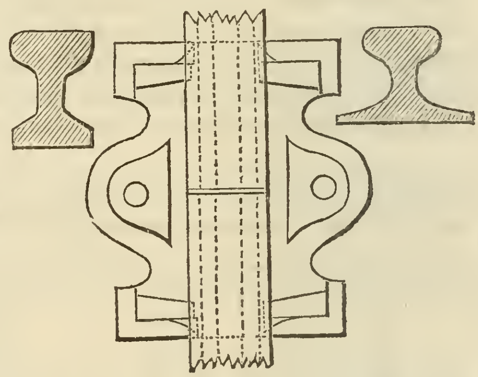


Fig. 3.

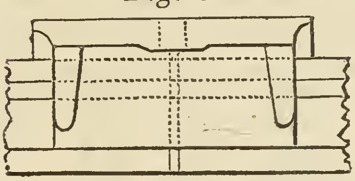


Fig. 1, is an end-section of the parallel rail and *joint*-pedestal (the pedestal where two ends of different lengths of rail meet); showing also the mode of keying the rail by cotter bolts. Fig. 2, is a plan of the above; and Fig. 3, a side section. The weight 50lbs. per yard. The stone blocks are from 10 to 12 inches thick, and contain from 4 to 5 cubic feet; the cotter bolts are $\frac{3}{4}$ inch round.

Fig. 4.

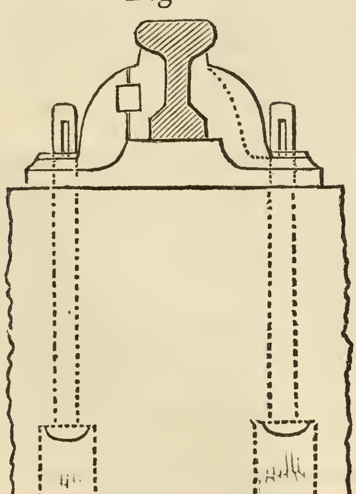
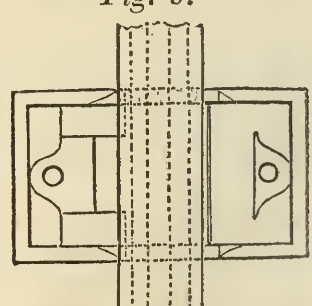


Fig. 5.



I have tried this form of rail against ten other forms of rail of the like weight per yard or thereabouts, not only by actually running heavy locomotive engines over them, but by means of the steelyard and lever, and have always found that it will carry more weight than any other with the

least deflection. The simplicity of its construction, too, is greatly in favor of its being soundly made.

Fig. 4, is an end section of the same kind of rail, with the *intermediate* pedestals; and Fig. 5, plan of the same.

The joint-pedestal is made of nearly twice the bearing of the intermediate ones, in order that the ends may be the more effectually secured.

Mr. Barlow made his experiments with my form of rail, which he pronounces to be by far the best, and recommends the mode which I proposed of fixing the pedestal to the stone block, *and not Mr. Swinburn's.*

Indeed, to all who are practically conversant with railways, it must seem as inexplicable as surprising, that the lewis-pin method should have been thought worthy of favorable mention at all, far less of being honoured with a premium. Were such a mode of fastening adopted (as it most assuredly never will), it would not be long before the concussions from the passage of heavy locomotive engines, at great velocities, would infallibly split the stone to the depth of the lewis.

The mode of fastening practised by me, and approved of by Mr. Barlow, consists, as will be partly seen from inspection of the figures, in inserting plain cotter bolts through the stone, and countersinking the hole up from the bottom for the space of an inch and a half or two inches, so as to permit the point of the bolt to drop below the base of the pedestal. I first tried screw-bolts, but was obliged to abandon them in consequence of the nuts getting, through corrosion, so fast to the bolts as to twist the bolt-ends off before they would unscrew. Fifteen years' experience has now satisfied me that the plain cotter bolt is the only one that will answer.

Mr. Barlow, speaks of this method of fastening as if it were the suggestion of Mr. Vignoles. But how he should have fallen into such a mistake, I cannot comprehend; for it was not only fully shown in the models I sent in to the London and Birmingham Railway Directors, but the advantages of it were particularly dwelt upon in the letter which accompanied them. To place this beyond all doubt, I will here repeat those passages of my letter which relate to this point:—

"The pedestal for the joint I would particularly recommend to be fastened to the sleeper with cotter bolts; I would also prefer fastening all the intermediate ones in like manner, though they would answer to be well nailed in the usual way, but much better with cotter bolts, as you then derive the greatest effect from the parallel rail, by keeping every pedestal firmly down. If only nailed, this may prevent the intermediate pedestals becoming fulcrums, in which case the fibres of the upper surface of the rail are not called into tension in the same ratio with those on the under side of the rail, immediately between the pedestals, while the locomotive or any other heavy carriages are passing along the line."

Again:—

"I prefer the mode of fastening the pedestals with cotter bolts as by far the most effectual for general use; if even they have to be fastened with smaller bolts (say $\frac{5}{8}$ths diameter), more especially when they can be thus secured at as cheap a rate as if fastened by nails. The holes for the small bolts can be drilled through the stone sleepers for less than the large holes necessary to receive the wooden plugs; and the small bolt and cotter will only cost a trifle more than the nail and wood plugs, as both the bolts and cotters can be made by a machine for that purpose."

Mr. Vignoles, though he certainly did not suggest the use of the cotter bolt, has done me the honour to cause it to be adopted in the construction of the Dublin and Kingstown Railway, instead of the nails or spikes commonly used.

Mr. Barlow makes some very forcible observations on the importance of exact fitting and fastening; but to show you that all practical men have not been so indifferent to these matters as Mr. Barlow imagines, I will, with your leave, make another short extract from my letter to the London and Birmingham Railway Directors, which has an immediate bearing upon this part of the subject:—

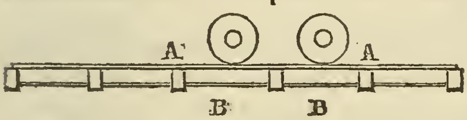
"I am quite sure a velocity of from 50 to 60 miles per hour may be obtained upon a well-constructed railway, with greater safety than one of 20 miles, upon any of the present lines yet in operation; not only from their having too light a rail and ill-constructed pedestal, but from the mode of fixing them, *especially at the joints*, which is the great cause of so much deflection and sudden action, both vertically and horizontally—so that it is not in the power of man to make a locomotive engine to stand the action they are subject to long together.

"I have frequently stated to companies, that every public railway ought to be laid down as accurate and as firm as it is possible for hands to do them; and, when that is done, to put a steam engine upon them to plane the surface, the same as we do our slide rails."

I must also use the freedom to observe that, correct as Mr. Barlow's views are, of the importance of executing all railways in the best possible style of workmanship, he shows in nearly all that regards the details, great want of practical knowledge. Speaking of keying the rails to the pedestals, he says, that "if the rails and chairs be not permanently fixed to each other by direct means, it ought not to be attempted by indirect means, viz. by cotter keys or wedges, for either these will hold the rail to the chair, or they will not; if they do hold fast, they produce all the mischief which permanent fixing would occasion; and if they draw, then they do no good, although they may still do mischief." Now, if the Professor ever had an opportunity of carefully watching for a summer's day the passing of heavy steam carriages and long trains of other heavy carriages over a railway, he would never have ventured such a statement. He would have witnessed, that it is scarcely in the power of man to fasten the rails permanently to the pedestals. Aware of the impracticability of doing so, I do not allow the D key proposed by me (see fig. 1), when used to key the rail to the *joint*-pedestal, to be driven with more than a single-hand hammer; and also stop it at its place when driven, the key being here merely intended to act as a steadiment to the rail. For before a locomotive engine or heavy train has passed twice over the rails, the whole of the keys give or yield of necessity in such a manner as to allow the rails to expand or contract more than what they really do, or are subject to, from the differences of temperature to which they are exposed. With respect, however, to the *intermediate* pedestals of the five-yard rails, the more soundly they are keyed to the rail the better, so as not to injure the pedestal by over-driving the key, as there is more latitude in the holes through the base of the pedestals where the bolts pass, than would compensate for treble the expansion and contraction the rails are subject to. Besides, each of the holes drilled through the stone blocks upon which the pedestals rest, is drilled $\frac{1}{8}$th of an inch larger than the diameter of the bolts, and the pedestals can never be so hard cottered down to the surface of the stone but what they will give a little. All difficulties on this head I got completely over several years back, in both wrought and cast-iron railways which have been laid under my direction. I could refer Mr. Barlow to several miles of railway which have been worked for years, and remain at

present perfectly firm without the least distortion, either vertically or horizontally.

Again: notwithstanding Mr. Barlow has actually proved by experiment that the parallel rail is superior to the parabolic, or fish-bellied rail, and has taken some pains to show the neutral axis, which has little or nothing to do with the best form of rail; yet he has forgotten to point out one of the most essential advantages which the parallel rail has over the parabolic rail, as I have frequently proved by the steelyard-lever. I have found that by holding the ends of the rails firmly down, at the joint-pedestal especially, the parallel rail of fifty pounds per yard will carry upwards of a ton more, with the same deflection, than the ends will do if they are allowed to rise, which they will of course do, if the end-pedestals are merely nailed down in the bad and ineffectual manner hitherto usual, namely, by common nails or spikes. When the rails are kept firmly down by proper means, the intermediate pedestals become so many fulcrums, and the tension of the fibres of the upper parts of the rail is called into play; as will be readily understood from inspection of the following diagram, in which A A represents the points of tension, and B B the points of deflection.



I perceive further from Mr. Barlow's experiments, that he considers that the best rail for strength ought to be from $4\frac{1}{4}$ to $4\frac{1}{2}$ inches deep, from the upper to the lower surface. I am quite confident, however, that it will be found that the best form of wrought iron rail ought not to exceed $3\frac{3}{4}$ inches deep, or 4 inches at most; for by making the rail higher, not only will the pedestal be much weakened, but there will be no possibility of holding the pedestals firm on their base, by cotter bolts or any thing else, more particularly at the shunts and curvatures of the line of railway, and even the stone blocks will be continually shaken. It is well known in practice, that the lower any rail and pedestal can be kept, the less is the destruction in them, and the less the action on the foundation upon which the stone blocks are placed. It is also equally well known, that a sufficient wrought iron rail can be made of the depth I have stated, (namely, $3\frac{3}{4}$ or 4 inches), to resist the action of a locomotive of 12 to 14 tons weight, at a speed of 40 or 50 miles per hour, (or even more if necessary,) if it is properly laid and adjusted.

I find that the different railway companies are now going to have their rails manufactured to weigh as much as 60lbs. per single yard. The additional 10lbs. per yard, ought, in my humble judgment, to be employed partly to strengthen the lower edge and make it rest more firmly on its basis, and partly to increase the width of the upper surface; both in the manner shown in fig. 6, which is a sectional view of what I consider the best form of a rail of this weight. My object in these modifications, is to increase the adhesion of the locomotive-engines, as well as to give a little more bearing on the peripheries of their wheels, in order to make them last longer.

I understand the Directors of the Birmingham and Liverpool Railway (the Grand Junction), have recently given an order for one or two thousand tons of parallel rails, the upper and lower edges of which are both alike. Now, the fact is, that twelve months ago, I gave one of their engineers a set of drawings, of rails and pedestals, of a variety of forms, *and this was one of them.* And in my letter to the Directors of the London and Bir-

mingham Railway, before quoted from, I also expressly made mention of this form of rail, as one that *might* be employed; but pointed out, at the same time certain objections to its use, which restrained me from proposing it for adoption. My words were these:—

"I have hesitated with myself, whether or not to make a pattern with the upper and lower edges exactly alike, so as to be able to use either side, in case the former should prove a little unsound in any part, which has hitherto been frequently the case, especially at the ends, as I am fully aware that the more metallic material that can be brought to the lower side, adds considerable strength to the rails; but as you seem disposed not to exceed 50lbs. per single yard, a little would be lost in the depth and height of the rail. Allow me to assure you, that no public railway company will ever regret having sufficient strength in the rails at the beginning, and that they ought not, by any means, to confine themselves to a pound or two in the yard, in order to make the work as complete and substantial as possible at the commencement. But, as it is, after mature consideration, and taking every thing into question, I prefer the models I have furnished (Nos. 8 and 9), as the keys will be more effectual."

Fig. 8, is a section of the form of rail that I recommended, and would still recommend, for adoption where it is desired to construct it, so that it may be inverted if necessary. It is what I call a "fancy rail," but ought to weigh at least 55 lbs. per yard.

Fig. 8.

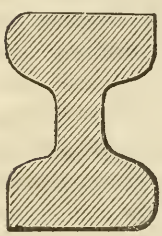
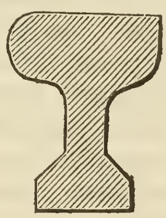


Fig. 9.



Where a railway is intended for locomotive engines of only from eight to ten tons weight, a rail of the form represented in fig. 9, and weighing only 45 lbs. per yard, will be found to answer sufficiently well.

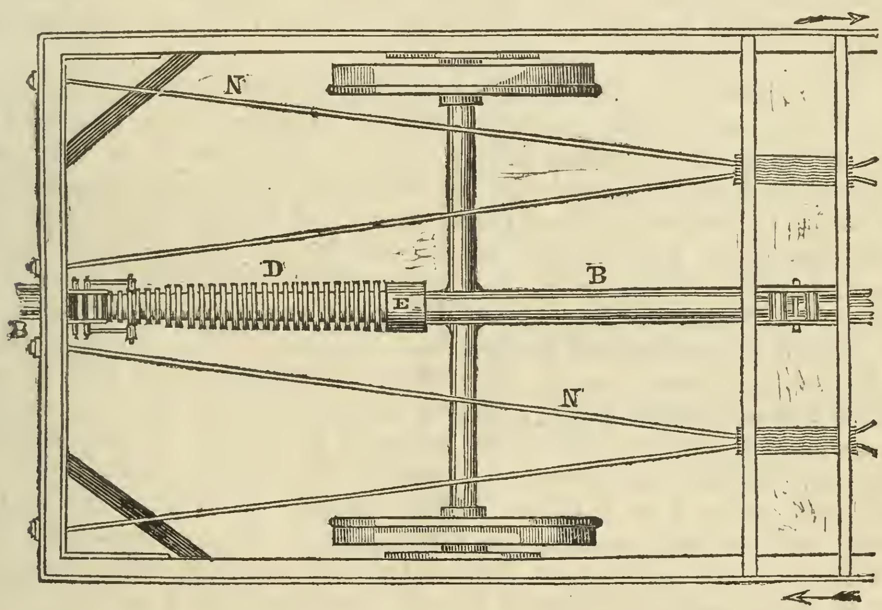
For America, where they have great difficulty in obtaining stone blocks, and are in the custom of fixing their rails on wooden sleepers of lengths varying from 30 to 50 feet, secured by cross sleepers, the best form of rail is that shown in fig. 7. I have been informed by American engineers that they can get plenty of a hard durable timber, very suitable for the purpose, for little more than the expense of cutting it down in the forests, and sending it to the saw mills to be cut into scantlings fit for immediate use; and that a railway bed of this description will last for nearly twenty years. Sometimes they lay their rails on cross sleepers only, dispensing with the side pieces. Several orders for rails of the form above referred to, are now executing under my inspection for railway companies in America.

Lond Mech. Mag.

Bergin's Patent Railway Buffing Apparatus. Immediately after commencing the traffic on the Liverpool and Manchester Railway (the first on which long trains of carriages were moved by locomotive engines at high velocities), it was found that every time a train was put in motion or stopped, violent concussions took place between the several carriages, equally disagreeable to the passengers and destructive to the carriages themselves. These concussions arose from the following cause: viz. by reason of the inertia of all heavy bodies, the same engine power which would be adequate to draw a given load along a railway at any required speed, would not be sufficient to start the same load from a state of rest; it was therefore necessary to connect the several carriages by chains of some considerable length, say three or four feet, by which arrangement the

inertia of the train was, as it were, divided into as many parts as there were carriages, and these several parts being each within the power of the engine, were overcome in succession; but as the first carriage would have attained a certain amount of velocity when the connecting chain came to pull the second, this second must of course be at once dragged from rest into motion at a speed nearly equal to that already acquired by the first, and so on through the entire train. Now a very slight knowledge of the principles of mechanics teaches that the concussions already mentioned were the necessary result of the action described; the same principle (inertia) produced the same effects at stopping a train, and also at every change in the relative velocities of the individual carriages when in motion; and as the force of these shocks was dependent on the velocities, the greater the speed of traveling the more violent they became.

The obvious remedy for the evil complained of was to provide a means by which the full amount of motion acquired by any part of the train should be gradually, not instantaneously, communicated to the other parts; the elasticity of a spring was a suitable means, and an apparatus was accordingly added to the Liverpool and Manchester passenger coaches, a sketch of which is annexed, and which has been termed a buffing-apparatus.



This apparatus is complex and consequently expensive; it also requires to be very strong, as on a little consideration it will be evident that the spring-bars, levers, and frame of the first carriage have to bear the resistance of the entire train; a very rigid spring is therefore necessary, the range of action of which is, of course, very limited, (in practice not exceeding a few inches,) consequently the concussions, although much diminished, are still very considerable. The apparatus being attached to the carriage-frame, which is, of course, supported on bearing springs, it rises and falls according to the load; whence it constantly occurs, from the carriages being unequally weighted, that the buffer-heads, opposed to each other, and which by right should be at the same level, vary by nearly their own diameter. Whence, in the event of a violent blow, the bars to which they are fastened are almost certain either to be bent so as not to play in their sockets, whereby the whole apparatus becomes inoperative; or else to be broken off,

(such we have found to be the case in every instance when an unusually severe blow took place). After the apparatus described was added to the Liverpool and Manchester carriages, it was found that the train no longer proceeded in a steady motion in the direction of the rails, but that each carriage had acquired a very considerable lateral motion, by which the flanges of the wheels were constantly striking or rubbing against the rails, so as to cause a considerable increased resistance from side friction; indeed, on looking along a train of six or eight carriages, the serpentine motion is very striking. The cause of this unsteady motion will be evident, when we recollect that the point from which each carriage is drawn is in one direction, the centre, and in the other the after extremity. These considerations, the result of numerous careful examinations of the carriages on the Liverpool and Manchester Railway previous to ordering our own, led me to seek for a remedy; as on the Dublin and Kingstown Railway, so very large a proportion of the traffic of which would be passengers, the extent of which it would be difficult to anticipate, but which must of necessity be immense, it became a matter of paramount importance to attain, as far as practicable, the most perfect comfort and security, and also to reduce as much as possible the wear and tear of the numerous carriages which the company must provide. The apparatus which I designed, and which has been successfully applied to thirty-five of our carriages may be thus described.

A slight frame of sheet-iron, consisting of two similar plates, three inches apart, each about $\frac{3}{16}$ thick, secured together by rivets, rests on turned bearings on the centres of the axles; a single bar B (I have used a welded iron tube of $\frac{5}{16}$ inches thick and three inches diameter, as being the stiffest), the entire length of the carriage, and extending about two feet beyond each end, passing through an oblong hole about three inches wide and nine inches long, is supported on this frame by rollers, allowing it to be moved lengthwise with great facility; on this tube or bar B is placed at either end (within the framing of the carriage) about four feet of spiral springs, D, of graduated strengths; one end of each of these sets of springs rests against a strong collar or boss, E, fixed to the bar or tube, and the other end against a small box of iron, attached to the frame and furnished with one of the rollers previously mentioned, also with two friction rollers projecting a little beyond its surface, and resting against the inner side of the carriage-frame end. To each extremity of the tube B B is attached a buffer head, by means of a bar of iron, passing through B B, and furnished with a nut and screw at each end; immediately within the buffer head, and resting against it, is a bar of iron, for attaching the carriages together. It will be observed, that this apparatus, lying loosely on the axles, is perfectly independent of the frame work of the carriage, which is supported in the usual manner on bearing springs, and, in consequence of the oblong holes rises or falls according to the load, without affecting the buffing-apparatus. The action of the apparatus is as follows:—The train being to be moved in the direction of the upper arrow, the motive power is applied and draws orward the central tube B B, thereby compressing the springs D between the boss E and the friction roller-box which rests against the end of the carriage-frame, without moving this latter until the elastic force of the compressed springs becomes sufficient to overcome the resistance presented by the friction and inertia of the carriage, when the latter begins to move forward so gently as not to be perceptible to persons seated there-

in; the second and each succeeding carriage in the train is by similar means brought from a state of rest into motion, as (altogether independent of the springs D) the tube B B acts merely as a simple connecting chain, rope, or bar, would. In case of a concussion from behind, or of one carriage running against another, it will be at once seen that the resistance is offered by the furthest end, the effect being to drive the tube B B forward, compressing the springs at the remote end; and the carriage will not be affected by the blow until (as in drawing the train) the elasticity communicated to the springs overpowers the inertia of the carriage, which then begins to move, actuated by a force just sufficient to start it; any ordinary velocity might be thus, theoretically, resisted by sufficient length of spring, without any strain or violence to the carriage receiving the blow; but, practically, the springs are limited to about four feet, allowing a range of action of about two feet, beginning to be compressed by a force equal to about twenty pounds, and presenting a gross resistance to entire compression of upwards of two tons, and which have been found sufficient for all practical purposes. It will be observed, that as the springs of each carriage act totally independent of each other, and of all the carriages in the train, except that to which they are attached, each has but to bear its own share of the resistance, the sum of which is made up of the separate resistances of all the springs acted on: thus, if one set offers a resistance equal to two tons receding through two feet, and that there be ten carriages in the train, the gross resistance to a concussion would be equal to twenty tons through two feet; and if the buffer-heads of each carriage were in contact, this great amount of resistance would be opposed without the carriages being necessarily moved forward as in the case of any obstruction on the rails, or any of them bearing more than two tons. On the contrary, in the other apparatus, supposing each spring also to resist a force of two tons, and to recede, as is the case in practice, about eight inches, each spring being acted on by all that preceded it, the resistance offered by a train of ten carriages would be but equal to two tons through ten times the space each separate spring moved, or $10 \times 8 = 80$ inches, or six feet eight inches; consequently the first and each succeeding carriage would, to enable all the springs to act, be forced through a space equal to the sum of the spaces through which the separate springs act; thus the first carriage of the ten would be forced through eight inches for each of the remaining nine carriages, or in all six feet, and it is easy to conceive the difference of the effect in the two cases. Experiments have been tried on this railway, by placing a single carriage, fitted with the new apparatus, on the rails, and running an engine and tender against it with a velocity of six to seven miles an hour, without producing any injurious effect. I have more than once sat in a carriage so struck, without sustaining any injury, or other effect, greater than is felt on starting a train of carriages fitted with the old apparatus.

Another effect which has been realised by the adoption of this apparatus, is a perfectly steady forward motion in the trains, whereby very much of the side friction of the flanges of the wheels against the rails is avoided; and instead of that undulating, lateral motion previously described, all the carriages constituting the train move forward in a steady path, as if they had not the power of motion independent of each other. Carriages are hereby rendered much less liable to go off the rails, and can be pushed before the engine in case of necessity with far greater confidence and less liability to accident; as although the impulse is given to the central bar from

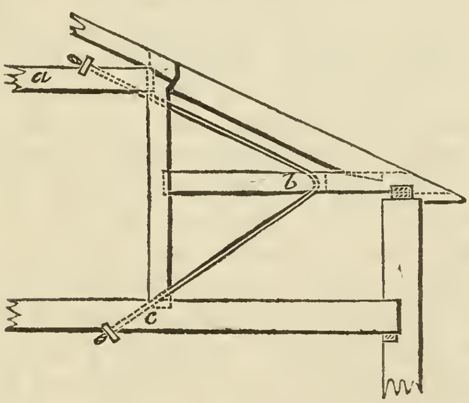
behind, yet it is obvious the carriage is acted upon from the front, precisely as it would be if drawn in the same direction. I have frequently, during our experimental trials before opening the railway, propelled one and two carriages in this manner at a velocity of thirty miles per hour with perfect safety. The diminution of side friction necessarily diminishes the power requisite to draw a train: the amount of saving in this respect I have as yet been unable to ascertain experimentally with sufficient accuracy to state in this place; I have, however, ascertained that it is very considerable.

One other object, of no trifling importance to a concern like the Dublin and Kingstown Railway, which must have an exceedingly large stock of carriages, is also effected; namely, a diminution of first cost of between 50*l.* and 60*l.* per carriage.

In describing the figures, I omitted to state that as the entire resistance to the action of the springs D is on the ends of the carriage-frame, the centre of each is armed with a strong plate of iron, about fifteen inches square, through which pass the tension rods N N to the outer angles of the opposite ends of the frame; consequently these rods receive the entire force of the springs. Lond. Mech. Mag.

Description of a new method of forming a Tie to a roof, where a direct Tie from Wall Plate to Wall Plate cannot be introduced. By W. Coles, Esq., Architect. Fig. 214, is a plan which I have found answer well as a tie to a roof, where a direct tie from plate to plate could not be introduced; and, as far as I know, it is original. I introduced it in this neighborhood in the roof of a cottage, in a case where the walls, having been carried up about four feet above the floor of the attic story, a direct tie across the building would have prevented the communication from one room to he other.

Fig. 214.



In the figure, a truss on the suspension principle is formed by a bar of iron (about three-quarters of an inch in diameter), which passes over the collar of the straining beam *a*, through a mortise in the tie *b*, and down through the floor-joist at *c*, and is tightened with a nut and screw at each end.

Kingsgate Street, Winchester, April, 1835. Lond. Architec. Mag.

Mechanics' Register.

Halley's Comet. The comet of 1835, when it came in 1456, was encountered by the anathemas of the whole Catholic Church, headed by the Pope. Dismayed at once by the progress of the Turks and the progress of the comet, Calixtus included them both in the same prayer of conjuration ordered to be said in all the churches.

It came again in 1531, and found America discovered, printing invented and in general use, and the reformation begun.*

1607 again completed its cycle. And now the *Copernican* system had been published to the world;† the *telescope* had been discovered; Galileo and Kepler had been born, and had probably laid the foundations of their discoveries, the one in mechanics, and the other in astronomy.

Next came 1682 and the comet, and the laws of motion were ascertained and published to the world; the discoveries of Kepler were made, and Newton had built up upon them the theory of universal gravitation.

1759 was to be the next period of its appearance, and its coming was now, for the first time, *foreseen*. Halley, afterwards Savilian Professor at Oxford, having undertaken to calculate the orbits of different comets which had, up to that time, been observed, presented, in 1705, to the Royal Society, a work called *Cometographia*, in which he predicted‡ the return of the comet of 1682 in 1758, an announcement received in those days with no little surprise and interest. It was, however, immediately foreseen by astronomers, that the path of this comet would be disturbed by the attraction of the planet Jupiter. Lalande and Clairaut undertook to calculate the amount of this disturbance. The work was one of enormous labour, which they would never have undertaken, as Lalande himself admits, had not assistance been rendered to them (strange to say) by a lady. To Madame Lepaute, the wife of a celebrated watch-maker in Paris, was assigned a principal portion of their calculations, and to that lady is due a principal share in their success. "During six months we calculated from morning till night, even during meals," says Lalande. They determined the actual perturbations, during 150 years, of Jupiter and Saturn, and they arrived finally, at the conclusion, that its coming would be delayed no less than 518 days by the attraction of Jupiter, and 100 more days by Saturn. The time of its perihelion passage§ was thus brought to 13th April, 1759: it was, nevertheless, stated that errors might have been made amounting to a month either way.

These conclusions Clairaut published to the world in November, 1758, when astronomers had already begun to look for the comet. It was first seen by a farmer of the name of Palitzch, near Dresden, on December 25, 1758, and at Paris, on January 21, 1759. It passed its perihelion on March 13, 1759, just one month after the time predicted.

The comet of 1759 was next to complete its orbit in 1835; and of its appearance in that year an account will shortly be given, when we shall first have answered two questions, which will, no doubt, have suggested themselves to every one who has read so far of this paper. They are these:

The comet of 1835 was, in its last revolution, influenced appreciably by the attractions of the four planets, Jupiter, Saturn, Uranus, and the Earth, and of course by the attraction of the Sun; and MM. Damoiseau and Pontécoulant, severally and independently, undertook the task of calculating their amount, and, separately, completed it. M. Pontécoulant found that the action of Jupiter would, as compared with the last revolution of

* This time is was accurately observed by one Apian, a Professor of mathematics, at Inglestadt.

† The great work of Copernicus, *De Revolutionibus*, was published in 1543.

‡ His words, translated, are, "Hence I dare venture to foretel that it will return again in 1758."

§ This term will be explained in the course of this paper.

the comet, on the whole accelerate it 135.34 days; that of Saturn, retard it 51.53 days; that of Uranus, retard it 6.07 days; and that of the Earth, 11.7 days. The principle portion of the influence of the Earth on its motions, dating as far back as the year 1759, or the very beginning of its revolution, at which time it passed very near the Earth.

Allowance being made for these, the whole period of the comet's last revolution was brought to 27937 days, and counting from the 13th of March, 1759, when it last passed through its perihelion, or nearest extremity of its orbit to the sun, this brought its next perihelion passage to the 13th of November, 1835.* At the same time M. Pontécoulant expressly stated, that there might be an error of a few days in this time, and assigned as a proximate cause of such an error, a possible incorrectness in the assumed masses of some of the planets. His words are, "we must here once more repeat, that it is not pretended that the time announced for the comet's return to its perihelion may not be in error some days." Elsewhere he says, " Thus then it is *conclusive that about the middle of November*, 1835, the passage of the comet through its perihelion will take place."

We next compare the results with the predictions. It had been announced that the comet would probably be visible during the first days of August. *It was seen on the 5th of August, at Rome,*† *by MM. Dumouchel and Vico*, its light being then exceedingly feeble. But more than this, the *precise place* in the heavens which the comet would occupy on every day whilst it should be visible, had been calculated and announced beforehand, *and it was when they directed their telescope to that point in the heavens which had been so predicted for the 5th of August, that MM. Dumouchel and Vico saw it.* It had been foretold that it would pass its perihelion on the 13th of November, that there might be an error of a few days, but that, nevertheless, it certainly would pass it about the middle of November. *It passed its perihelion on the* 16*th of November.*

It had been assigned by M. Pontécoulant, as a reason for the uncertainty which he thus felt in respect to the time of the perihelion passage, amounting, however, only to a few days, that the masses usually assigned to some of the planets by astronomers, and used by him in his calculations, might require correction. Of all the planets, Jupiter exercised the greatest influence over the motions of this comet. Any error in the mass which had been assigned to Jupiter, would, therefore, most affect the result. Now the mass he had assigned to Jupiter, was such, that 1054 such masses would equal the mass of the sun. Recent observations have shown, that the mass of Jupiter repeated only 1049 times, would equal the mass of the sun; and it has been ascertained, that *if M. Pontécoulant had used in his calculation this corrected measurement of the mass of Jupiter, instead of that which he did use, it would have protracted the predicted time of the perihelion passage three days, and brought it to the* 16*th, and to within six hours of the time when it actually took place,—an error of six hours in a period of seventy-six years!* Lond, Mag. Pop. Sc.

Gas Lighting. On Feb. 28, at the Royal Institution, after a brief sketch of the origin and progress of gas-illumination in London and its environs, Mr. Brande proceeded to details connected with the present state of the manufacture, illustrating the various sources of its extension and improvement. He began by adverting to the curious and complicated pro-

* M. Damoiseau fixed its perihelion passage to the 4th of November.

† The reader need not be reminded how pure and clear is the atmosphere of Rome.

ducts resulting from the destructive distillation of pit-coal; the principal elements of which he stated to be carbon, hydrogen, oxygen, and nitrogen, in conjunction with sulphur and iron derived chiefly from pyrites; these substances, by their mutual action during the application of a heat gradually raised to redness, yield olefiant gas, carburetted hydrogen, hydrocarbonous vapours, naphtha, naphthalin, tar, carbonic acid and oxide, cyanogen, hydrocyanic and sulphocyanic acids, sulphuretted hydrogen, ammonia, and several of its salts, water, and certain other products, of which a copious table was shown, containing also a statement of the relative proportions of gas, condensible products, and coke, afforded by three varieties of coal. Models and drawings of gas apparatus were then described, especially as illustrating the different modes of setting the retorts; and the progress of the gas from them was traced through the hydraulic main, where the tar, water, and ammoniacal liquor, are chiefly deposited to the condensers, purifiers, and gasometers. Some observations were then made in reference to the uses and properties of the various products, in the following order:—

1. *Ammoniacal Liquor.* This was shown to be a complicated solution of several ammoniacal and cyanic compounds in water. It is extensively used for the production of muriate of ammonia, which is obtained by saturating it with muriatic acid, evaporating, crystalizing, carefully drying the crystalized salt, and subliming it into large leaden receivers. A beautiful specimen of this salt, prepared by Mr. Leeson, of Greenwich, and weighing 2 cwt., was exhibited. Sulphate of ammonia is also prepared from the liquor; this, in its dry, crystalline state, is mixed with carbonate of lime, and affords carbonate of ammonia, of which a large mass, prepared by Mr. Leeson, was also shown. The presence of sulphocyanic and hydrocyanic acid in the ammoniacal liquor was shown by saturating it with muriatic acid, and adding persulphate of iron: the detection of these compounds and their application to the manufacture of Prussian blue, Mr. Brande said was owing to the skill and ingenuity of Mr. Lowe. This product, therefore, of the gas manufacture, once considered as useless, yields a variety of useful and important compounds, and has opened a new field of chemical art.

2. *Tar.*—This product is useful as a coarse paint, and for the purpose of paying and caulking vessels: it is also more importantly applicable as fuel in the gas-works, where, mixed with water, it is suffered to dribble into the fire; three gallons of this mixture per hour being sufficient to heat five retorts. When distilled, it yields naphtha, a highly volatile and inflammable liquid, which is occasionally burned in lamps, or used as a solvent in the manufacture of certain varnishes.

3. *Lime Liquor.*—This is the mixture of lime and water, through which the gas has been passed, chiefly with a view of freeing it from carbonic acid and sulphuretted hydrogen: it is from time to time drawn from the purifiers and suffered to subside. The deposit, or thick portion, is made again into lime, or is used for luting the retort-lids; the clear portion is pumped into shallow vessels placed in the ash-pits of the retort-furnaces, where it evaporates, and tends to preserve the bars, probably by keeping them cool. Another use, however, is now made of it, as follows:—Acid persulphate of iron (copperas liquor) is added to it, which throws down a green precipitate, that may itself be used as a paint, but which, digested in a solution of potash, yields a ferrocyanate of potash, sufficiently pure to throw down Prussian blue from common copperas liquor.

4. *Gas.*—The specific gravity of the purified gas, and, consequently, its

composition, vary considerably at different periods of the distillation; its average specific gravity, as taken from the gasometers, is 0.410; each cubic foot weighing 240 grains. After some remarks upon the manufacture of gas generally, and upon the various forms of carbon, and other products occasionally found in the retorts, Mr. Brande made some observations upon the sources of the luminosity of different gases, and on photometers; and then proceeded to details connected with the process as carried on upon the large scale by the different companies; stating that his experience was chiefly derived from the Chartered Gas Company, the officers of which had most assiduously assisted him in all inquiries connected with the subject generally, and with the particular object of the present inquiry; Mr. Lowe, and Mr. Frederick Winsor, had kindly given him access to their information; and Mr. Crossley had supplied models of gas-meters and their appendages, with much of the other apparatus upon the table. Mr. Brande estimated the number of retorts worked by the above-mentioned company at 750; and assuming them to be about one-fourth of the number employed in London, the whole amount will be 3,000 retorts, of about 15 cwt. each; so that the cast iron thus employed, to say nothing of the enormous amount in pipes and other apparatus, amounts to 2,240 tons. The total stowage for gas in the gasometers of the chartered company, Mr. Brande estimated at 820,000 cubic feet; or, for London, 3,280,000 cubic feet. He said, that the number of burners supplied by this company amounted to about 42,000; or, for the whole of London, to 168,000; and, estimating the consumption of each burner at five cubic feet per hour, the average *hourly* consumption of gas would amount to 840,000 cubic feet; and taking five hours per day as the average time of burning, we have 4,200,000 cubic feet of gas as the daily average consumption. Mr. Brande concluded by explaining the different checks resorted to by the companies in reference to the quantity of gas produced and consumed; and by a description of the gas-meters, pressure-gauges, tell-tales, and governors, all illustrated by a series of excellent models and apparatus. The following tables were exhibited, as furnishing data and details connected with several of the points referred to in this lecture, together with some others which we have not room for, showing the relative weights and volumes of gas, and of the consumption of atmospheric air in its combustion:—

For the total annual supply of gas to the metropolis, there are required 200,000 chaldrons of coal, yielding 2,400,000,000 cubic feet of gas; the gas weighing 75,000,000 lbs. The light thus produced is equal to 160,000,000 lbs. of mould candles, of six to the pound; the bulk of the coal is equal to 10,800,000 cubic feet, or 400,000 cubic yards; or to a cube of 222 feet in the side, or of 74 yards. Arcana of Science, 1835.

List of American Patents which issued in June, 1836.

(CONTINUED FROM PAGE 215.)

453. *Dry dock.*—J. Houston, A. Kinman, & J. Ingraham, Buffalo, N. Y. 22
454. *Horse collars, forming.*—G. Warner and R. Robinson, Canajoharie, N. Y. 22
455. *Raising water.*—Jesse C. Wood, Euphrata, N. Y. 22
456. *Fence pickets, cutting.*—J. Tichnor, S. Goodrick, & G. A. Hart, Ithaca,. Y. 22
457. *Straw, corn, &c. cutting.*—E. Tarbox and C. F. Kneeland, Ogden, N. Y. 22
458. *Wheel plough.*—J. C. Ferguson, Hydesville, Missouri, 22
459. *Wagon tilts.*—Stephen Beebe, Norwich, Conn. 22
460. *Cotton, spinning.*—William P. Brayton, N. Y. 25
461. *Chocolate, grinding.*—G. W. Wait, Baltimore, 25
462. *Chocolate, moulding.*—G. W. Wait, Baltimore, 25
463. *Chocolate ingredients, heating.*—George W. Wait, Baltimore, 25
464. *Churn.*—Samuel Tyler, New Gloucester, Maine, 25
465. *Planing machine.*—P. M. Martz, Marion county, Ind. 25
466. *Oven, reflecting.*—Benj. Ames, Ithaca, N. Y. 25
467. *Hair and oakum, picking.*—Robert B Lewis, Hallowell, Maine, 25
468. *Cooking stove.*—Gould Thorp, N. Y. 25
469. *Water heating machine.*—D. B. Barnum, N. Fairfield, Conn. 25
470. *Distilling.*—Peter Swartz, Jr. Muncey, Penn. 25
471. *Cooking stove.*—Thomas Shaw, North Yarmouth, Maine, 25
472. *Flyers for cotton spinning.*—Jason Morse, Newtown, Mass. 25
473. *Water wheels.*—Orson Waldo, Newark, Tioga county, N. Y. 25
474. *Palm leaf hats.*—Fred. Groening, Brooklyn, N. Y. 25
475. *Planing machine.*—Ira Gay, Dunstable, N. H. 25
476. *Thrashing machine.*—Peter Cleveland, Yancy mills, Va. 25
477. *Rotary steam engine.*—Shepherd Whitman, New Albany, Ind. 25
478. *Parlour grates.*—William Anderson, N. Y. 25
479. *Boot cramp.*—Hubbard L. Pierce, St. Johnsbury, Vt. 25
480. *Vegetable cutter.*—Henry Mellish, Walpole, N. H. 25
481. *Saddles.*—Benjamin Kraft, Reading, Penn. 28
482. *Compass, surveyors.*—Nathan Bassett, Wilmington, Del. 28
483. *Harvesting machine.*—H. Moore and J. Hascall, Kalamanzo, Mich. 28
484. *Cars, Rail Road attaching.*—L. Pickering and J. Lightner, Boston, Mass. 28
485. *Steam power.*—William Avery, Syracuse, N. Y. 28
486. *Power loom.*—Benjamin Lapham, Waterford, N. Y. 28
487. *Cooking stoves.*—Sebastian H. Laciar, Macungy, Penn. 28
488. *Buildings, constructing.*—Lewis Knapp, N. Y. 28
489. *Feathers, dressing.*—Benton P. Coston, Philadelphia, 28
490. *Drawing knife.*—Edmund Richards, Hingham, Mass. 28
491. *Chair, easy.*—Andrew Wood, Charlestown, Va. 28
492. *Spoons, casting.*—William Mix, Prospect, Conn. 28
493. *Cooking stove.*—P. F. Perry, Rockingham, Vermont, 28
494. *Plane, revolving.*—Samuel Hedge, Brattleboro' Vermont, 28
495. *Clover seed, hulling.*—J. Hopper and A. Douty, Moresborough, Penn. 30
496. *Pottery, moulding.*—J. C. Mendell and R. B. Ricketts, Maysville, Ky. 30
497. *Mowing machine.*—John Drummond, Waterford, N. Y. 30
498. *Leather, glazed.*—E. G. Adams, Decatur, Georgia, 30
499. *Horse power.*—John Abbott, South Reading, Mass. 30
500. *Bitt-stock.*—Jeremy Taylor, Hebron, Conn. 30
501. *Stoves.*—James Atwater, New Haven, Conn. 30
502. *Saw mill.*—Simon Willard, N. Y. 30
503. *Cultivator.*—J. S. Eastman, Baltimore, 30
504. *Parlour stove.*—Beriah Douglass, Albany, N. Y. 30
505. *Cooking stove.*—Beriah Douglass, Albany, N. Y. 30
506. *Pump.*—Abraham T. Mixsell, Oxford, N. J. 30
507. *Over shoes.*—Daniel H. Bond, Canterbury, Conn. 30
508. *Hides, unhairing.*—James Banks, Dexmont, Maine, 30
509. *Bee hive.*—John M. Weeks, Salisbury, Vermont, 30
510. *Sawing staves.*—Chas. M. Keller, Washington, D. C. 30
511. *Crane.*—Gilbert Sherwood, Erie, Penn. 30
512. *Raising vessels.*—Tobias Cook, Scituate, Mass. 30

CELESTIAL PHENOMENA, FOR NOVEMBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.			
2	17	28	Im ι Leonis ,6,	N. 39°	V.358°
2	18	49	Em	258	240
21	8	52	Im 53 Arietis ,6,	173	130
21	9	44	Em	255	224
23	14	3	N. App. ☽ and k Tauri ,6, ☽ North 3′.0		
26	16	52	Im c Geminorum ,6,	13	64
26	17	35	Em	311	8
28	9	7	Im Cancri ,6,	119	73
28	9	51	Em	225	176
29	12	1	Im η Leonis ,3.4,	77	24
29	13	1	Em	247	194

Meteorological Observations for July, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	64°	86°	29.85	29.85	W.	Moderate.		Hazy—clear.
	2	67	83	29.85	29.85	SW.	do.		Fog—clear, sultry.
	3	68	81	29.90	29.90	S. ES.	do.		Fog—lightly cloudy,
	4	71	82	29.90	29.85	SW.	do.		Cloudy—flying clouds.
☽	5	72	86	29.85	29.85	SW.	do.		Cloudy—clear.
	6	70	82	29.86	29.86	W.	Brisk.		Lightly cloudy—clear.
	7	70	88	29.90	29.93	W.	Moderate.		Clear, do.
	8	70	85	29.80	29.80	W.	do.		Clear—lightly cloudy.
	9	70	80	29.80	29.75	SW.	do.		Clear—floating clouds.
	10	74	78	29.70	29.80	N.	do.		Lightly cloudy.
	11	66	80	29.85	29.00	N. E.	do.		Clear, do.
	12	68	76	29.90	29.90	N.NE.	do.		Cloudy—lightly cloudy.
⊗	13	70	80	29.85	29.85	E.	do.		Cloudy—lightly cloudy.
	14	70	82	29.80	29.80	E.	do.		Rain—Cloudy,
	15	60	71	29.80	29.85	E.	do.	1.00	Rain—rain.
	16	64	74	29.94	29.96	NE.	Brisk.		Clear—flying clouds.
	17	58	74	30.00	30.05	N.	do.		Clear day.
	18	58	78	30.30	30.20	N.	Moderate.		Clear day.
	19	64	80	30.10	30.10	W.	do.		Clear day.
	20	64	84	29.95	29.86	NS.	Brisk.		Clear day.
	21	67	81	29.70	29.65	SW.	Moderate.	.02	Lightly cloudy—rain in night.
☾	22	69	81	29.54	29.54	S. E.	do.	1.05	Lightly cloudy, do
	23	62	78	29.75	29.80	SE.	do.		Clear—flying clouds.
	24	64	78	29.80	29.83	SW.	Brisk.	.50	Cloudy, do. rain in night.
	25	68	79	29.83	29.90	NW.	Moderate.		Cloudy—flying clouds.
	26	67	66	29.80	29.83	N.	do.	.60	Cloudy—rain.
	27	62	73	29.95	29.95	SE.S.	do.		Clear day.
☺	28	66	75	29.90	29.90	SE.S.	do.		Cloudy—lightly cloudy,
	29	66	79	29.85	29.80	S.	Brisk.		Cloudy—lightly cloudy.
	30	70	80	29.65	29.65	W.	Moderate,	.03	Drizzle—cloudy.
	31	68	81	29.80	29.85	W.	do.		Clear day.
	Mean	75.39	79.39	29.85	29.87			3.20	

	Thermometer.	Barometer.
Maximum height during the month.	88. on 7th.	30.50 on 17th,
Minimum do.	58. on 17th & 18th.	29.54 on 22nd,
Mean do.	72.89	29.86

JOURNAL

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DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

NOVEMBER, 1836.

Practical and Theoretical Mechanics.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II., *containing the* GENERAL REPORT *of the Committee.*

(CONTINUED FROM p. 132.)

27. *First. Unduly heated metal may result from a deficiency of water within a boiler.* This seems to be a frequent and generally acknowledged source of explosion. The forcing-pump, by which a boiler is supplied with water, if at first well regulated, so as to furnish an adequate supply, and if kept constantly in action by the machinery, is subsequently liable to derangement of various kinds. The valves may be put out of order, the passages to or from the pump may be choked by sedimentary, or saline, matter. The pump may in some cases be heated so as to inject steam and not water. Any accident of this sort will cut off the due supply of water, and the level of that within the boiler will be lowered more or less rapidly. This will be true of self-acting, as well as of ordinary, means of supplying boilers. No one we believe has yet been applied, the working of which can, at all times, be relied on. There are, besides, cases in which the forcing-pump is not in action, when the production and use, or waste, of steam is going forward. In some stationary engines, the feeding of the boiler only goes on at inter-

vals, and the due supply is therefore dependant on the attention of the fireman. The same is true of steamboat boilers when the boat stops at a landing, and indeed the mischief is frequently increased by opening the safety-valve by hand, and allowing the steam, and of course the water, to waste freely. By an approximate calculation* it may be seen that to lower the water one inch in a cylindrical boiler with an interior furnace, or in a boiler of the same form where the fire is applied directly to the exterior, and with an interior flue, will require but from five to nine minutes. If by this depression an interior flue of eighteen inches should be laid bare for an inch in depth, between 102 and 103 square inches of surface would be subjected to the action of the fire, for every foot in length of the flue, supposed level.

28. It thus appears that by accident, or in the ordinary management of the steam engine, a deficiency of water may occur, and highly heated metal be produced within a boiler. Recorded instances show that such has frequently been the case.†

29. The metal, then, being softened by heat, may give way to the ordinary working pressure of the steam. This will, of course, depend upon the amount of this pressure, and upon the temperature which the metal has reached. The frequent rupture of boilers near the usual water-line, and in a horizontal plane containing very various thicknesses of metal, would lead us to suspect that this is connected with undue heating, which if all circumstances were equal in the parts of a boiler, would take effect equally, at equal distances from the water-line. But the Committee have not before them any well established instance in which a boiler without interior flues has exploded merely by the ordinary pressure of the steam, when the boiler had been unduly heated. The case of the explosion of a cylindrical boiler, at the foundry of Mr. McQueen, in New York, may have been an exception to this remark, but the fact of the water having been very low, though rendered probable, is not entirely made out.‡ The

* In the case of a cylindrical boiler with an interior furnace and flue, calling l the length of fire-surface, d the diameter of the furnace, and π the ratio of the circumference of a circle to its diameter, $\pi\, l\, d =$ the extent of fire-surface. Then since in a boiler of this kind 1 sq. foot (144 sq. inches) of fire-surface can convert into steam .356 cub. inches of water, per second; $\pi\, l\, d \times \frac{.356}{144} =$ the number of cubic inches of water vaporized per second. Again if we denote by x, the depression in the water level in one second, c the breadth of the water-line, and assume the length of the boiler to be equal to that of the interior cylinder, $x\, c\, l$ will be an approximate value for the quantity of water vaporized. Equating the two values found, and cancelling l, we have $\pi\, d \times \frac{.356}{144} = x\, c$. The depth of water may be assumed at two-thirds the diameter of the exterior cylinder, which, calling D that diameter, gives $c = .98$ D, and $\pi\, d \times \frac{.356}{144} = .98\, x$ D. The ratio of d to D in a number of cases in practice varies from .4 to .6 and even .7; taking the lower limit or $d = .4$ D, we have $.4\, \pi\, \text{D} \times \frac{.356}{144} = .98\, x$ D. Whence $x = .003$ inches per second. Or to lower the level one inch would require 5 mins. 16 secs., supposing the water not to reach the interior flue.

For a cylinder with an interior flue, but where the fire is applied, externally, supposing the effective fire-surface to be half that of the boiler, the depression per second, will not be less than two-thousanths of an inch.

† As instances, may be taken, the boiler of the steamboat Huntress, No. VII. Replies, &c. of the Western Engineer, No. II, Replies, &c. Legislator, Eagle, and Massachusetts, No. XVII. Replies, &c. Explosions at Pittsburg, No. XII. Replies, &c. and Jour. Frank. Inst. vol. iii. p. 70.

‡ Thomas Ewbank "On the Explosion of Steam Boilers," Jour. Frank. Inst. vol. x. p. 3. That the pressure was unusually great, is satisfactorily shown; and with or without undue heating, was, no doubt, the cause of the explosion. In the case of the Etna,

copper boiler exploded in the experiments of the Committee, may be considered, however, as illustrating the possibility of such an occurrence.* The explosions in boilers with interior flues, arising from these circumstances, have been found to affect those flues which "collapse," that is, are crushed, and rent, and are frequently separated from the boiler. The case of the accident on board the steamboat Patriot, which occurred near the mouth of the river Ohio, in 1828, distinctly illustrates this point.† It is stated that the engine was kept in motion after it was known that the water was below the flues; an act of temerity which was followed by the collapse of one of the flues.

30. It is highly probable, as will be seen hereafter, that water is thrown upon the hot metal, in cases where the engine has just been set in motion, or when the safety-valve has been opened, just prior to an explosion, and hence we are not warranted in adducing such cases here.

31. The following, is a well authenticated instance in which the pressure was not sufficient to produce explosion, or in which the metal was cooled by its change of figure, but when the danger was obviously imminent. It was that of the boiler of the steamboat Legislator,‡ of which an oval flue was flattened by exposure to the steam pressure, when known to be unduly heated. An explosion was avoided by the fire being put out, as soon as the deficiency of water was ascertained.

32. The Committee next proceed to consider the means which have been pointed out, by which, in the event of an undue heating of a boiler, water may obtain access to the heated metal.

Various means by which water may be brought into contact with heated metal, have been suggested. This may occur by the intentional or accidental removal of an obstruction, or by some other repair, to a forcing-pump,§ or by the injection of water by a hand-pump.‖ When it is recollected that one cubic inch of water will produce six hundred and twenty-one cubic inches of steam of three atmospheres, or one hundred and eighty-nine inches of steam of eleven atmospheres, and that this steam is produced far more rapidly than in the usual action of the boiler, we are at no loss to understand that an ordinary safety-valve cannot give vent to it. The explosions on board of the steamboats Grampus, Constitution, &c., should serve as warnings against the introduction of water into a boiler under such circumstances, and the course taken by the engineer of the Legislator as an example to be followed. In this latter case there can be no doubt, from the circumstances stated by Mr. Lester,¶ that an explosion

the boiler was unduly heated, but, whether it gave way to the pressure, ascertained from the working of the engine, to be lower than usual, or whether water had access to the hot metal, is not known.

* Report of the Committee on Explosions, Part I. p. 68. Jour. Frank. Inst. vol. xvii. p. 225.

† Replies to Circular, &c. No. XXI. Thomas J. Haldermann, Esq. The explosion on board the Tricolour might be cited as another example. The boat was at rest. No. XXI. Replies, &c.

‡ Replies to Circular, No. XVII. E. A. Lester, Esq. of Boston.

§ In the case of the boilers of the Car of Commerce, (No. VII. Replies, &c.) of the Grampus, (No. XII. Replies, &c.,) &c.

‖ See explosion of a boiler at Aston Forge, (No. XI. of Replies, &c.). Boiler of the steamboat Constitution, (No. VIII. of Replies, &c.,) &c.

¶ See Replies to Circular of Com. on Explosions, No. XVII. Letter of E. A. Lester Esq., to Sec. of Treasury.

was prevented by cooling the boilers previous to the introduction of water, when the deficiency was discovered. No circumstance of mere convenience, should be suffered to interfere with such a course.

33. A second means assigned for bringing water in contact with unduly heated metal in a boiler, is by the foaming produced by the opening of a safety-valve, or in the ordinary working of the engine. This foaming has been abundantly demonstrated, and a detailed statement of the direct experiments made on the subject by this Committee, may be seen in their report to the Secretary of the Treasury of the United States.* Since the foaming is caused by making an opening in the boiler, it may be supposed that it cannot be adequate to do more than to produce steam to supply the place of that which escapes. This view of the subject derives some support from the experiments incidentally made by M. Arago,† and directly with this object by the Committee, but is contradicted by those of M. M. Tabareau and Rey.‡ In the experiments of M. Arago, the boilers were not unduly heated; in those of the Committee, there was present a considerable amount of heated metal, and in those last referred to, and in which an increase in the elasticity of the steam was produced by opening a safety-valve upon a small boiler, the boiler was surrounded by a charcoal fire. There can be little doubt, then, that the result must depend upon the precise circumstances of the case, and that danger *may* result, though it does not *necessarily* follow, from making an opening in the boiler when the water is low. This effect from foaming would be increased, if in addition to the agitation produced by the first working of the engine, after stopping, the safety-valve should be opened. This was the common practice on the Hudson, a few years since; the safety-valve being opened, by hand, on putting the boat in motion after the landing or taking up of passengers.

34. The successive explosions of connected boilers such as occurred at the Polgooth§ mines, and on board the steamboat Rhone,‖ are easily explained if referred to the effect of foaming, and difficult to understand on any other principle, since just before the explosion of the second boiler a large opening was made for the escape of steam.¶

35. It has been assumed by our countryman Perkins, in his hypothesis on the subject of the explosion of steam boilers, that the hot steam formed by contact with unduly heated metal is the true source of danger. This opinion has been shown to be inconsistent with the deductions from sound theory.** The injection of water into hot and unsaturated steam, should

* Reply to query first. "To ascertain, by direct experiment, whether on relieving water heated to, or above, the boiling point, from pressure, any commotion is produced in the fluid." See also a paper by Mr. F. Peale, whose observations were contemporaneous with experiments of the Com. Jour. Frank. Inst., vol. viii. p. 145, and Replies, &c. No. XXI. Potts on Explosions, Jour. Frank. Inst., vol. vi. p. 327.

† M. Arago. Sur les explosions, &c. Annuaire du Bureau des Long., 1830, pp. 148, and 180, and Jour. Frank. Inst., vol. v. p. 404, and vol. vi. p. 47.

‡ Ibid.

§ J. Taylor, Esq. "On the accidents incident to Steam Boilers." Lond. Philos. Mag. vol. i., 1827.

‖ Annuaire du Bureau des Long., 1830, and Jour. Frank. vol. v. p. 401.

¶ The same opinion is expressed by M. Arago, Annuaire, &c. p. 184. Translated in Jour. Frank. Inst., vol. vi., p. 49. The other cases referred to by him, in which an explosion followed the opening of a stop-cock by hand, as at Lyons, or of a safety-valve by the steam, as at Essone, may be explained by supposing the openings insufficient to give vent to the steam, which was produced by the action of the boiler, in the circumstances then existing.

**Dulong. Annales de Chim. et de Phys. vol. xlviii.

reduce, not increase, its elasticity. With a view to ascertain if any circumstances had been omitted in the application of theory to this problem, the Committee made direct experiments on the subject. The water was introduced both in a full stream, and through small apertures. In no case, an increase, and in all but one a perceptible decrease, of elasticity in the hot and unsaturated steam, was observed. Fourteen ounces of water, injected into steam at 533° reduced its pressure .34 of an atmosphere.* The steam had in this experiment a temperature corresponding to the pressure of sixty atmospheres,† and an actual elasticity of only 6.82 atmospheres. There was besides a fire which supplied heat, as it was absorbed by the vaporization of the injected water.

36. A correspondent has suggested‡ that when a steamboat is first set in motion, the inertia of the water may cause it to rise at one end of the boiler and then to oscillate, by which it would be thrown upon parts of the boiler which might be unduly heated. This is no doubt a true cause, but it would be difficult to say to what extent it would be effective. The subsequent suggestion that water can take a charge of heat in a latent state, which may be rendered free by mechanical means, the Committee do not conceive to be valid. Experiments which have been referred to as showing this, are fully explicable upon well established principles.

37. There are two other important circumstances to be examined falling under this division of the subject, namely, the effect of the careening of a boat, especially one having connected boilers, and the effects of the sudden cracking of deposits of mud or sediment, beneath which the metal is unduly heated. These will, however, be treated under separate heads.

38. The Committee now proceed to examine *the means proposed for preventing the occurrence of the dangerous circumstances now under discussion.* These of course have reference, mainly, to the original source of the danger, that is to the deficiency of water within the boiler, though an avoidance of the secondary causes might prove effectual.

39. First.—Various self-regulating apparatus for the supply of boilers have been proposed and partially used. Second.—Methods for ascertaining the level of the water or of giving notice when it falls to a certain level, are in use, or have been suggested. Third.—Some methods for ascertaining the temperature of the boiler, or of particular parts of it, have been contrived.

40. 1st. One of the most common methods of regulating the supply of water to a boiler is by the use of the float. This is understood to have been entirely successful in the low pressure boiler, the float being applied to raise a valve connecting a reservoir of water with the boiler to be supplied. A self-feeding apparatus in which a float was used was proposed by Mr. Charles Potts,§ who exhibited to the Franklin Institute a very neat working model, in which a glass boiler was kept at nearly a constant level by this

* In a certain theoretical case, namely, that in which all the heat to vaporize the injected water, is derived, from the hot steam, and the quantity of water which that steam can vaporize, without reduction of temperature below that of saturated vapour of the same elasticity, is injected, the precise reduction of elasticity has been calculated by M. Dulong. See Ann. de Chim. et de Phys., vol. xlviii., p. 378.

† Calculated from the formula deduced by M. M. Arago and Dulong from their experiments.

‡ Replies to Circular of Com. on Explosions, No. XX.

§ Journal of the Franklin Institute, vol. vi. p. 42, and also p. 327, &c., where the apparatus is illustrated by a figure.

method. Its application is most difficult in the case of a small high pressure boiler with interior flues.

Engineers differ very much in the amount of confidence which is to be placed in the float: those who have seen it in operation in the large boiler of a low pressure engine give it implicit confidence, others who have tried it in the small high pressure boiler consider its action too uncertain to answer a good purpose,* even when in its best form. If the objections to the float are not valid, and we apprehend that they are only partially so, the real difficulty will be found to lie in general objections to all self-regulating apparatus. This obviously is one which is liable to get out of order since it communicates between the exterior and interior of a boiler, and hence must have a packed joint, liable when the stem is not in constant motion to become tight, and therefore beyond the power of the change of buoyancy in the float to move.

41. A most ingenious method of feeding boilers was patented in 1825, by Mr. Eve.† It consisted of a revolving cock, bored in part through, and playing alternately into the boiler, and into a box of water. It was expected that this cock being placed at a proper level of the water within a boiler, would merely draw out and return water while this was at a due height, but when it sunk too low would draw out steam and return water. The difficulty of condensing the high steam‡ drawn out, and of making the returned water flow out of the openings, seems to have rendered this, as well as other promising schemes of the same sort, abortive.§ An attempt to obviate these objections which was seen by some of the members of this Committee was unsuccessful. Mr. Charles Potts‖ has recently proposed a plan which is similar in principle. It will have to encounter the difficulty of the flow of water from moderately large openings when the pressure on the two ends of the column is the same, and the necessity for the alternate heating and cooling of the revolving plug or chamber which acts as a feeder, and of at least a part of its contents. They agree entirely, however, with the Committee on Science and the Arts that this principle merits further trial.¶

42. The Committee are decidedly of opinion that no self-feeding apparatus has been, or is likely to be, invented which can be a substitute for the care of an engineer; and, indeed, they consider the carelessness which is liable to result from their use as a very serious, though not an insuperable, objection to them.

43. 2nd. Methods for ascertaining the level of the water in a boiler, or of giving notice when it falls to a certain level.

The imperfection of the gauge-cocks in ordinary use has been often pointed out, and indeed is generally admitted. Originating in the very infancy

* D. J. Burr on the explosion of steam boilers. Jour. Frank. Inst., vol. vi. p. 335. Mr. Redfield objects to its use in steamboat boilers, see Report to Secy. Tres. U. S. in Doc. H. R., No. 478, session 1831—2.

† Lond. Jour. of Arts, vol. xii. p. 230., Lond. Mechs. Mag. vol. vii. p. 344, Rep. Pat. Invent. vol. iii. p. 70. A revolving wheel for the same purpose has been patented by Mr. Jesse Fox. Jour. Frank. Inst. vol. x. p. 161.

‡ See also J. S. Williams' patent for supplying boilers with water. Jour. Frank. Inst. vol. vii. p. 183, which though different in action is liable to this objection, in even greater force.

§ Walker's feeding plug. Trans. Soc. Arts, &c., vol. L. part i. p. 63. Sliding valve and box. Lond. Mechs. Mag. vol. xxi. p. 376.

‖ Journal of the Franklin Institute, May, 1836, vol. xvii. p. 302.

¶ Report on a "Plan of a new pump for feeding steam boilers." Jour. Frank. Inst. vol. xviii, p. 3. 1836.

of the art in Savery's engine, they remain at this day, a stain upon its more mature age. At best,* when the water is tranquil within a boiler, they only show, roughly, the position of the water line; and when it is above the highest cock, or below the lowest, they fail entirely; and cannot be placed far apart without making their indications, within these limits, too rude even for practice. When a boiler is in action, particularly if it is small and contains high pressure steam, the foaming is so considerable as to interfere with their use. In the report of experiments by this Committee, abundant evidence is to be found of this imperfection; as an example of which may be taken the case, where by raising the safety-valve, of the small experimental boiler, indications of water appeared at a gauge-cock, below which the hydrostatic level was known to be nearly two inches.†

44. The method of indicating the level of the water by a float‡ is liable to all the objections urged against the feeding apparatus, depending for its action upon that instrument. It has not, however, except in very rare cases, been used in this country. An alarm float was tried by the Committee, which is not subject to the objection in regard to the stuffing-box, since it is entirely within the boiler. This is by no means a new device,§ though the particular arrangement was made by Mr. D. H. Mason for the Committee; and is figured and described in the first part of their report.‖ This device is intended to allow the escape of a small jet of steam whenever the water rises above, or falls below, a determinate level.¶ The alarm by the issue of steam through a trumpet tube, being only applicable to engines working at very low pressures, does not require special notice here.

45. With due care on the part of the Engineer, and the Committee are of opinion that no substitute has yet been found for such care, the glass tube affords the best means known to us, for observing the level of the water within a boiler. It seems strange that this excellent device which has stood the test both of experiment and of practice, has met with so limited a degree of favour. In the great progress made of late years, in the locomotive engine, it has been so clearly shown that engineers and their assistants can be induced to employ any machinery, the use of which is insisted upon, that the excuse of their indisposition to change should not be urged any longer. In this very case, in which the glass tube, is probably more exposed to fracture, than in any other, it is practically used. The objection on the score of its breaking by unequal expansion and contraction

* From the remarks which follow, exclusive of the objection on the score of the effect of foaming, we must except the shifting gauge-cock of Mr. Philos. Tyler described in Jour. Frank. Inst., vol. xv. p. 178.

† Report of Com. on Explosions, Part I. pp. 11, 12, &c. Jour. Frank. Inst., vol. xvii. pp. 9, 10. Peale on the height of water in boilers of locomotives, Jour. Frank. Inst., vol. viii. and Replies No. XXI. Potts on explosions. Jour. Frank. Inst. vol. vi. p. 329.

‡ The hydrostat described in No. XXX. of replies is inadmissible, from the interior of the boiler being occupied by a second cylinder leaving only an annular space for the production of steam. For the alarm floats of J. L. Sullivan, Esq., see Silliman's Journal, vol. xx. p. 1.

§ See the alarm float of Siebe. Lond. Jour. of Arts, vol. xiii. p. 273. The first of those known to the Committee.

‖ Report p. p. 14, 15, Plate 4, Fig. A. Jour. Prank. Inst. vol. xvii. pp. 13, 14.

¶ It is exposed to a slight objection from steam pressure acting to keep the disks upon the openings, these latter are, however, quite small, and the pressing surfaces of the disks may be regulated accordingly.

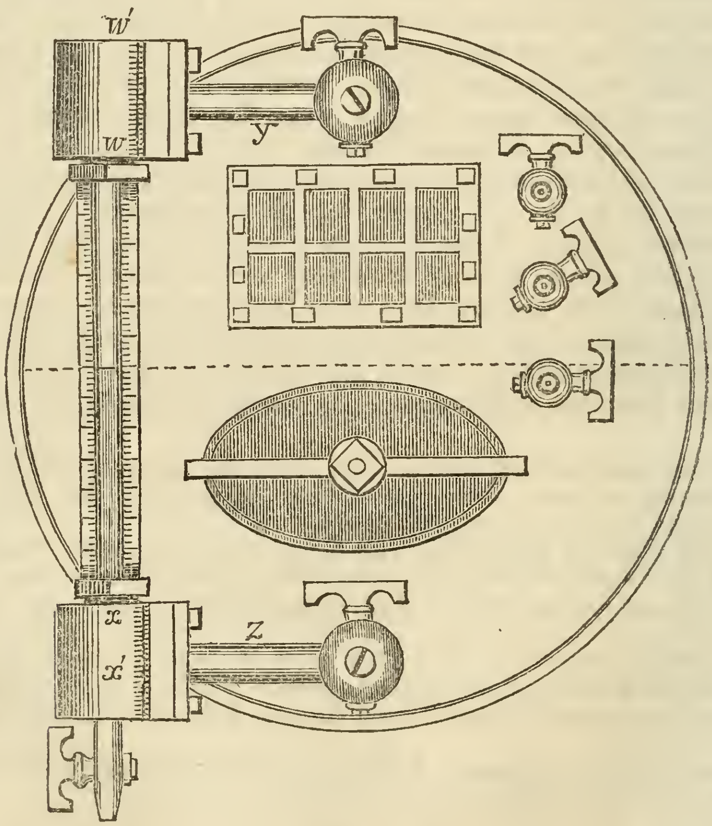
The float described by Mr. Ewbank, Jour. Frank. Inst. vol. x. p. 7, is also referred to by the Committee as deserving a full trial.

of the glass, and of the metal with which it is connected, has been obviated, by passing the ends of the tube into stuffing boxes; that on the score of its breaking by shocks, by giving it great thickness; and that of its breaking by sudden variations of temperature by using well annealed glass. The difficulty of the glass clouding when high steam is used, by the action of the steam on the alkali, is got rid of by using green glass. The experiments which the Committee made on this apparatus, were highly satisfactory and they confidently recommend its use to practical men.*

46. 3rd. The danger resulting from a deficient supply of water, being produced by the undue heating of parts of a boiler, many means have been proposed for showing such an increase of temperature, before it attains a dangerous degree. The fusible plates applied to the top of the boiler may be intended to indicate the general temperature of the steam when saturated with moisture or not, or the local temperature resulting from the rising of hot and unsaturated steam, produced by unduly heated metal.

* The following description of the tube water gauge used by the Committee is taken from the first part of their report, p. 12, &c. (Jour. Frank. Inst. vol. xvii. p. 10).

"The tube gauge is shown in the annexed figure. $w\,x$ is a tube of green glass passing into the stuffing boxes, $w'\,x'$; the stuffing enables an adjustment to be made for the unequal expansion of the glass and metal by heat, and prevents fracture on the subsequent cooling of the apparatus. y and z, are pipes connecting the tube with the boiler; these have conical terminations, by which the pipes are readily attached to, and detached from, the tubes connecting them with the boiler, which are provided with



stop-cocks: coupling screws might, in practice, be substituted for these conical terminations. To protect the tube, $w\,x$, from currents of air, it was surrounded by a second tube, loosely applied. A scale was attached to $w\,x$, to indicate the level of the water within the boiler.

In any case they will be exposed to pressure; though to less in the second case than in the first. The objections already urged, and derived from experiment, will apply to their use, in the ordinary way, in any one of these cases. Indeed without this objection, it appears that as the source of danger is the heated metal, to this the indicator of temperature should be applied.

47. Various methods of indicating the temperature of a part, or parts, of a boiler have been contrived. One of the most simple is to apply the common thermometer, inserting the bulb and as much of the stem as is necessary, in a tube closed at one end and fastened into the boiler. The tube should contain mercury, through which the heat is conducted to the thermometer. Such a tube may be placed at, or near, the water line of a boiler, at the fire end of a flue, or in general at the place of greatest exposure to heat from a deficiency of water, of which there will usually be one or more well determined, according to the form of the boiler. A mark upon the scale of the thermometer will show the temperature above which the metal must not be allowed to rise, either from an increased elastic force in the steam, or from a deficient supply of water. The fragility of the instrument, its inconvenient length, or position in certain cases, and its not acting as an alarm, are the principal objections to its use.*

48. The expanding rods proposed by Mr. Cadwallader Evans are ingenious; they give, however, not the local temperature of the boiler, but its general temperature, along the lines to which the rods are applied. A much more appropriate device, is the application of fusible metal proposed by the same gentleman.† This is intended to take the place of the ordinary fusible plate, and to avoid the difficulty, originally existing, but since remedied‡, of replacing the plate when it had fused. In the apparatus submitted to the Committee§ by their chairman, and subsequently made the object of experiment, the fusible metal is applied to the most exposed part of a boiler: it is so small in quantity, that it will serve to indicate a local temperature, while the motion which indicates its fusion is independent of the quantity of fusible metal. These instruments are intended, respectively to give notice when the steam, or the metal of the boiler is exposed to a temperature much below that which would produce danger. Both of them, after giving an alarm, can be immediately restored to action if the temperature within has been made to decrease.‖

* For a detailed description of the mode of applying the thermometer see the report of Com. on Expl. Part. I. pages 7 and 8, and Jour. Frank. Inst. vol. xvii. pp. 5, 6.

† Communication to Com. on Explosion, No. XXII. of Replies, &c. Jour. Frank. Inst. vol. ix. February, 1832. Patented in May, 1834. See specification in Jour. Frank. Inst. vol. xiv. p. 391. The Committee prefer this to the apparatus acting by the expansion of mercury.

‡ Hall's method of applying the fusible plate. Bulletin de la Soc. d'Encouragement, &c.

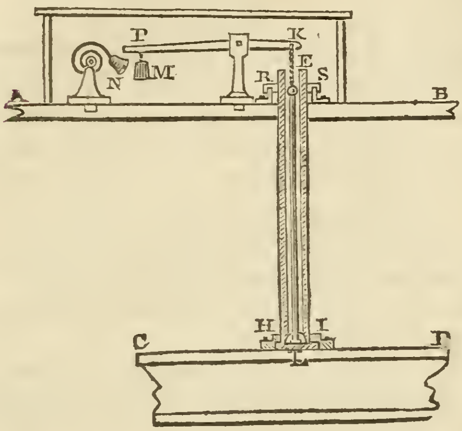
§ Described in Jour. Frank. Inst. vol. x. p. 217.

‖ The apparatus devised by the Chairman of this Committee, was made the subject of experiments, and, with them, is thus described in Part I. of the Report of Com. on Expl. It is obviously as applicable to a common boiler, as to one with interior flues.

"A tube of iron, or copper," according to the material of the boiler, "closed at the lower end, passes through the top of the boiler, its closed end reaching the flue to which it is attached." "This tube, it will be observed, affords a ready access to the flue, to ascertain its temperature, without any restraint from packing." "A mass of fusible metal placed at the bottom of the tube," "will become fluid very nearly as soon as the flue takes the temperature of the fusion of the alloy." "To show when the metal at the bottom of the tube becomes fluid, a stem is attached with a cord and

By very simple changes in the apparatus, the fusible metal might be applied to the boilers of locomotive engines.

weight," "or with a lever and weight." "The weight and longer arm of the lever, descending, may be made to ring a bell, or, by appropriate attachments, to turn a cock, permitting just enough steam to issue to give the alarm, and then to be closed at once. A projection on the lower end of the rod prevents it from being drawn from the metal until this latter is fused, and by widening the lower part of the tube, making it slightly tapering, the metal is kept from being drawn out by the rod."



In the annexed figure "AB is a section through the top of the boiler; CD, a corresponding section of its flue; EH represents a tube closed at the lower end, which is attached to the upper side of the flue. The mode of attachment by a projection on the tube and a ring screwed to the flue, is shown in the figure, as also the stuffing box RS, through which the upper end of the tube passes. The lower part HI, of the tube, is made tapering, to retain the fusible metal. KL is the stem, the lower part being inclosed by the fusible metal, the upper part attached by a chain to a lever KP. The weight M, draws the rod KL upwards, and on the fusion of the alloy HI carries the lever below the bell N, which being attached to a spring, rings an alarm."

The form of this apparatus, which was subjected to trial by the Committee, was essentially the same with that described. One of the tubes in which the thermometers were ordinarily placed, was used to contain the fusible metal, and as giving the more severe test, the short one entering only into the steam, was selected. For the convenience of removing the metal, it was placed in a metallic case, fitting loosely into the iron tube, and having a wire attached, by which it could be drawn out of the tube. This certainly diminished the sensibility of the apparatus, particularly, as the case was quite as thick as the enclosing tube, and as there was a small space between its convex surface and that of the tube; it was required, however, for the convenience of the experiments.

The results of the several trials are contained in the following table. The temperature was registered by the adjoining thermometer dipping into the water of the boiler, and already often referred to; it was raised as rapidly as possible in all the experiments except the first. The first four trials were made on an occasion specially devoted to this purpose, the last two were made incidentally when upon another subject.

Number of trial.	Temperature. Fah.°	REMARKS.
1	268	Stem rises. No particular attention paid to raising the temperature rapidly.
2	270	Stem rises. Steam raised rapidly.
3		Metal drawn out and suffered to cool, re-deposited cold in tube. Steam at 258°, and raised to 274° in 2½ minutes.
	274	Stem rises.
4		Metal drawn out and cooled. Steam at 250°, when metal was replaced. Steam rises at 274° in 3 minutes.
	274	Stem rises.
	252	Metal had become solid again. Steam let off rapidly.
5	270	Melted below this temperature.
6	256	Stem rises. Metal remains in a soft solid, so that the stem can be drawn out, until 240°.

A fact noticed during the experiments on fusible alloys was again verified in these;

49. *Second.—The undue heating of parts of a boiler may be produced by deposites.*

No cause of undue heating is better made out than this one, and the remedy is of the most simple kind.

The water of all rivers contains, in suspension, in greater or less quantities, the muddy particles detached from their banks or beds, and may contain in solution, salts derived from the same sources, or from the springs which supply the stream. The water of springs generally contains so large an impregnation of saline matter, as to decompose soap. The rivers of our Atlantic States, where perfectly fresh, contain few dissolved impurities, while many of those of the Western States are highly charged with calcareous matter. When waters holding substances in suspension, or solution, are evaporated, a sediment is deposited, varying in nature with the water employed. As the quantity of solid matter contained in the water varies, so the time required for such a deposite to take place, from the feeding water of a steam boiler, must be very variable. If a deposite is allowed to remain in a boiler, it gradually increases in thickness and in density; the heat which before passed rapidly from the metal to the water, is now impeded by a mass of viscid or of solid matter, which is a bad circulator or conductor of heat, and the temperature of the metal rises. The sediment thus heated increases in denseness, and may even form a hard crust upon the bottom of the boiler. A complete non-conducting coat is thus formed, which, if from its nature liable to crack or fissure, may allow water to have access to the heated metal below, and produce an explosion. This supposition is, however, as will be seen, by no means necessary to such a result. The most usual action of the sediment would seem to be as follows. When it has accumulated in thickness, sufficiently to produce a temperature in the metal, at which its strength is inadequate to bear the pressure without extending, it yields, and becoming more and more attenuated, finally bursts. It seems that the first yielding may bring water in contact with the metal so as to cool it, when the steam produced is not sufficient materially to increase the pressure within the boiler. Thus the attenuation may increase for a considerable time and gradually, and at last the bursting not produce any more injurious effect than to stop the working of the engine.

Accidental circumstances of figure, heat, &c., seem frequently to determine the places of deposite of these masses of sediment, but it is principally observed at the fire-end of the boiler, where its presence is most dangerous.

namely, that the mixtures of metals require a considerable time te change their state of solidity, or of fluidity, so that in the former case they may be raised, if heated rapidly, above the true temperature of fluidity, and in the latter case they may be cooled much below this temperature, without solidifying. The alloy used in these experiments appears to have put the apparatus very fully upon its trial in this respect, and the experiments were performed so rapidly as to give a further severe test. On the occasion devoted to the trials when the steam was not urged up with its greatest rapidity, the stem was drawn out at 268° when more rapidly at 270°, and with the fire at its maximum intensity, when the water was raised in temperature 24° in three minutes, the stem was drawn out at 274°. In other experiments it gave way at 256°. The range is 18° Fah. corresponding at ten atmospheres, to less than two atmospheres, under the test of very severe comparisons. There appears no reason to doubt, that when tested by no more rigid modes than practice would furnish, this apparatus would not only apply as an alarm to prevent undue heating of the parts of the boiler, but as a manageable, and useful check, in ordinary cases, upon the safety-valve. Report &c. Part I. and Jour. Frank. Inst. vol. xvii. p. 85.

50. The Committee have derived much information of a practical kind on this subject, and coming as it does from entirely different quarters of the country, where the water depositing the sediment was of different qualities, the details agree very remarkably.

Col. S. H. Long* describes a deposite found in one of the boilers of the Western Engineer, a boat used in the exploring expedition of 1818. The sediment had collected in less than two days so as to be two inches thick, and was found in parts of the boiler, where, from its construction, the heat was greatest. A difficulty in making steam enough for the supply of the engine, was observed, and induced an examination of the boilers, in one of which, the metal at a particular spot was found to have been made to project an inch and a half. In this case timely precaution prevented further evil consequences.

51. The plan of "blowing off" the lower parts of the fluid in a boiler, which is very generally used in turbid streams to the West, is, no doubt, of considerable service while the boat is running, but should never be used as a substitute for cleaning the boilers, when opportunity is afforded for this complete operation. Indeed it must be carefully executed, since if the flues are bared by it, any deposite upon them may become hardened before the boiler is replenished with water.

52. A practical engineer of New Albany, Indiana, Mr. Benton,† states that he has found deposites in boilers, used on our western waters, "almost as hard as the iron itself." These consist of a mixture of calcareous matter with the ordinary mud of the rivers.

The very consistent and satisfactory accounts given of the explosion of a boiler of the steamboat Caledonia, on the Mississippi, show that the disaster had its origin, at least in part, in the deposite within the boiler. The boat had eight connected cylinder boilers of wrought iron, for high steam, thirty inches in diameter and twenty feet long, with interior flues. The engine had been in operation for seven consecutive days, prior to the accident, and had, just before its occurrence, been stopped for about eight hours, to repair the machinery. During the time of stopping, the boilers were not blown out, and two hours after resuming the working of the engine the explosion occurred. On subsequent examination, it was found to have occurred in a patch, which had been put on the year before with *copper* rivets; the sediment on the bottom of the boiler was found to have been heated, so as to render it very hard. The rent began at about one-third of the diameter of the boiler from the bottom, that is, at, or near, the fire line, and passed upwards. The sediment had caused the heating of the copper rivets, and, it is probable, that the working pressure of the steam accomplished the rest.

53. The effect of a deposite of a different kind, in a boiler, near Richmond, Virginia, is well described by Mr. Burr.‡ The boiler was of wrought-iron, five-sixteenths of an inch thick; the water used for its supply was a chalybeate, but not so strong as to prevent its common use, as a beverage, by the workmen. A few weeks after the engine had been put in operation, a crack was observed in the boiler, just over the fire, and on examination, a deposite of oxide of iron was found in this place. The fire-end is stated to have been lowest in the setting of the boiler. A plate of wrought iron was substituted for that which had cracked. In four or five weeks a swelling began to form upon this plate, which continued to

* Replies to Circular of Com. on Expl. No. II.

† Reply to Circular of Com. on Expl., by Erasmus W. Benton, No. VIII.

‡ Jour. Frank. Inst., vol. vi. p. 334.

increase until it attained a considerable size, and in ten days from the first on which the protuberance had been observed, the boiler burst. No great damage was done. The iron was found to have been diminished in thickness, at the spot where the rent occurred, to one-eighth of an inch.

54. The deposites in boilers using salt water are no less dangerous. Mr. Lester* gives an account of the case of the boilers in the steamboat Eagle, of Boston, which leaked after being in use two or three weeks, and on examination were found to contain a deposite of from two to three inches thick, and which, in some parts, was so hard as to require the use of a hammer and chisel to remove it.†

55. Various other cases are on record of the effects of deposites in boilers, but the characteristic ones which have been selected convey all the information necessary. They show that no rule as to the time of cleansing a boiler can be general, and fully enforce the necessity for care upon this point. Farinaceous substances introduced into a boiler may tend to render frequent cleansing less necessary in cases of sedimentary matter, but cannot dispense with it.‡ Sound economy, as well as safety, require frequent cleansing of a boiler using hard or muddy water. The least that can happen, after the accumulation of sediment, is the injury of the boiler, perhaps its bursting, and a true explosion may result. Two violent explosions, at Bowen's mill,§ and at McMickle's mill in Pittsburgh, are fairly attributable to the effect of sediment, and there does not appear, in either case, to have been a deficiency of water at the time of the explosion.

56. The accidental introduction of materials which are bad conductors of heat within a boiler, may produce the same effect as the deposites just described. Mr. Benton‖ suggests that loose packing from the steam cylinder is sometimes passed through the force-pump and collecting under the flues, causes them to be highly heated. M. Arago mentions an instance of a rent made in a boiler, at Paris,¶ by the accidental resting of a rag on the bottom of the boiler.

57. Frequent cleansing of the boiler, or blowing out the lowest portions by small quantities at a time, are the true preventives to accidents from deposites. Besides them, however, the use of chemical reagents has been proposed for limestone water, and filtering in the case of muddy water.

* Letter to Sec. Treas. U. S. Replies to Com. on Expl., No. XVII. See also Jour. Frank. Inst., vol. vii. p. 289, &c.

† In a letter to the editor of the Jour. Frank. Inst., a gentleman of Boston, states that in a boiler using salt water, a deposite of more than two inches in thickness occurred in less than twenty days. Mr. West states that deposites, chiefly of sulphate of lime, occur in from one to six weeks of use, in the boilers at Manchester. See Jour. Royal Institution, vol. i. p. 42. See also F. Naested's letter to Sec. Treas. U. S., Doc. H. Rep. U. S., 1832-3, No. 478, p. 52.

‡ It was stated on the authority of Sig. Ferrari, that coarse charcoal prevents or removes deposites in boilers. (Jour. Frank. Inst. vol. ix. p. 420.) The Society of Arts of London awarded in 1833, a premium to Mr. Jas. Bedford for rendering deposites readily removeable by introducing sperm oil into the boiler. We are not aware to what extent this device has been tried. (Trans. Soc. Arts. vol. xlix. Part II. p. 88.) The use of grease for the same purpose is recommended in the Lond. Mechs. Mag. vol. vi. p. 308, and in the same Journal (Vol. ii. p. 206.) it is stated that the radicles of barley produced in the process of malting prevent deposites. These act on the same principle as the fecula of potatoes. They merely retard the formation of a deposite, and by rendering the fluid viscid, no doubt ultimately affect the generation of steam.

§ Replies to Circular, &c. No. XII. Letter of Thos. W. Bakewell, Esq. to Sec. Treas. U. S.

‖ Replies, &c. No. VIII.

¶ Used in producing steam to heat the exchange.

The former of these would prove but a partial remedy, and in unskilful hands would be dangerous, and the latter would probably be objected to on the score of its considerable expense. When the escape steam is allowed to run to waste this would be especially the case.

58. It has been also proposed to use boxes for collecting the sediment, but from them the Committee would not anticipate any very good result, though they might, in part, facilitate the cleansing of a boiler.

59. *Third.—The careening of a steamboat may expose parts of the boiler to heat without their being covered by water, and a subsequent return to its level will bring water in contact with the heated metal.*

There is no evidence known to the Committee that the careening of a boat has ever produced accident in any other than the small connected cylinder boilers, so extensively used in the boats navigating the western waters. In these, the danger has been forcibly pointed out by several correspondents,* and means of remedying it suggested.† These boilers communicate by pipes below the ordinary water level, and are supplied by the same forcing-pump. The fire is most generally applied to the exterior of the boilers, and they have besides interior flues. Being placed side by side, the length of the boiler being parallel to the keel of the boat, they occupy according to their size and number a more or less considerable portion of its breadth. The six contiguous boilers of the steamboat Helen McGregor, and the eight of the Caledonia occupied certainly not less than twenty-two feet in breadth of the boat. Calculating upon the dimensions of the boilers in the first named boat, and taking into view the circumstances under which the water has access to the heated metal, we find that a depression of nine inches, at the extreme boiler, taking place about the axis of the set of boilers, would expose a surface of boiler and flue together competent to supply, when the water returned upon them, one-third more steam than the ordinary working of the boiler could furnish: this supply being kept up, at an average, during the cooling of the elevated boilers to their ordinary working temperature. This danger might easily be met by an increased area of safety-valve, if indeed those commonly used would be insufficient, for the escape of the extra steam.‡ But the danger from even the working pressure acting upon the metal, of which the tenacity has been much decreased, is the real source of danger, and is not thus to be parried. There are but about 440 degrees of Farenheit's scale between the working pressure of eleven atmospheres, and a red heat visible in the dark.

This careening of the boat is liable to occur at every landing place and to last for a considerable time. Whenever a passing boat, an engaging view, or accident, shall call the passengers to one side of the boat it will be thrown out of trim.

60. In the small boats on our Atlantic rivers there are heavy carriages used to keep the deck level; these are also used in the English steam-packets which carry sails, but the Committee are not aware that they are employed in the boats of our western waters.

* The first communication made to the Committee on this subject was by James J. Rush, Esq. of the firm of Rush and Muhlenberg; by some accident the drawings presented by him were not deposited among the papers of the Committee, and a similar diagram to that of Mr. Rush being afterwards presented by Mr. C. Evans was published among the Replies to the Circular of the Com., No. XXII.

† Replies to Circular, &c. No. XXII. Earle on Explosions, Jour. Frank. Inst. vol. vii. p. 154.

‡ We are not able to make the calculation corresponding to this remark, not having the dimensions of the safety-valve, or valves, of the boilers of any one of the western Boats.

61. *Different modes of remedying the evil under discussion, and to be applied to the boilers themselves have been suggested.*

The first of these which came before the Committee, and which we believe has been applied in practice, was by Mr. James J. Rush. Doors are placed in the flues, at a point furthest from the fire-end, which, when opened, check the draught through the furnace and flues, and consequently prevent their becoming unduly heated. These are to be thrown open at each landing place. They do not, however, meet the case of accidental careening of the boat, unless made self-acting by expanding rods, as was proposed by Mr. Rush. They expose the flues to the action of air containing its full supply of oxygen, and must tend therefore to oxidize them more rapidly than in the ordinary wear of the engine.

62. The other devices before the Committee are those of Mr. C. Evans,* and of Mr. J. S. Williams.† The first places the mouth of the feeding-pipe just below the proper level of the water in the boiler, so that it shall be laid bare by a change of level, and the water be prevented from escaping from the higher boilers. This would remedy the evil, except in cases where the careening was sufficiently long continued to exhaust the upper boilers of water by the ordinary working of the engine; those boilers of which the supply pipes are bare not being likely to receive any supply from the pump. Mr. Williams places the supply pipes below the boilers and feeds through valves opening upwards, which of course prevent any return of water. The valves in this machine and also those proposed by Mr. Evans, to prevent any escape of water from the higher boilers, would be objectionable. The method of cleansing the pipes proposed by Mr. Evans is very ingenious.

63. After a careful examination of these devices, the Committee are of opinion that they present but partial remedies for the evils which they are intended to meet, and they consider that nothing less than detaching these boilers from each other, and feeding them singly, or at most in pairs, will prove effectual. They would therefore, respectfully, but earnestly, urge this upon constructors and owners.

64. *Fourth. Are there cases in which the metal of a boiler may become unduly heated when in contact with water?*

After much reflection and examination the Committee are of opinion that such cases *may* occur. They believe that such have occurred, though not frequently, and that with the common thicknesses of iron and copper boilers, and modes of arranging the furnaces, there is very little liability of their occurrence. Still it is well to recognise that such may be the case, as it may prevent accident by watchfulness in the use of a new construction of boiler, or application of the fire.

65. Mr. F. Graff‡ mentions specially an instance "in which the heads of the bolts burning off over the fire-place, and the joints parting;" "the boiling water passed into the ash pit." From his known carefulness, there is no reason to suspect that there was sediment in this boiler, which was one of the low pressure boilers used at the Philadelphia water-works.

66. Mr. Hebert§ gives two cases, in the first three different rents of an

* Replies to Circular, &c. No. XXII.

† Jour. Frank. Inst. vol. viii. p. 289. The method adopted by Mr. W. C. Redfield, places the means of feeding separately, or in the connected way, within the control of the engineer. This was not presented to the Committee, but may be found alluded to in the Documents of the House of Representatives of the United States, 1832-3, No. 478, p. 17.

‡ Letter to Councils. Replies to Circular, &c., 4th of No. I.

§ Replies, &c. No. XI.

iron boiler occurred at the same spot, at different times. Previous to the first "disruption, there was observed a bulging, or swelling out, of the metal, which gradually increased until it became nearly of a hemispherical figure, when it burst open and let the water out of the boiler into the fire. The boiler was repaired by putting a thick patch of malleable plate iron over the hole, when after about six weeks wear and exposure to the fire, this metal bulged out again, and burst asunder; a third patch was substituted, and in about a similar period of time was destroyed in like manner." "The cause of these ruptures appeared upon investigation to be owing to a partial and very intense heat impinging against that particular spot where they took place." If to this detail had been added proofs that the first rupture was not caused by sediment, nor by a defect in the metal, the evidence would have been complete. It is not, however, probable, that either of these causes were actually operative, since the second and third plates are stated to have bulged out, in the manner of the first, and if sediment had collected at this spot, it could not thrice have escaped notice. The defect in malleable iron, to which the Committee alluded above, is the want of connection in parts of a plate, resulting from imperfect welding before rolling, and which sometimes separates the plates into distinct layers, for a considerable extent.

In the communication just referred to, Mr. Hebert further states, that the disruption of a boiler, occurring twice in the same place, was traced by Mr. John Martineau, a respectable engineer of London, to the impinging of a current of air upon this spot.

67. A case apparently of the kind now under discussion, but which was found subsequently, to be due to the imperfect union of the parts of a sheet of metal of the boiler is as follows: Part of a boiler belonging to Messrs. Merrick and Agnew, of this city, was observed to be protruded, in a similar way to that described by Mr. Hebert. Suspecting the presence of sediment, the boiler was examined and found to be clean. It was a cylindrical boiler, of wrought iron, the fire applied on the exterior and at one end, and without interior flues. The fuel was anthracite coal. The effect was next attributed to the intense local heat produced by this fuel, and the grate bars being lowered the swelling made no further progress. It has been since ascertained that there was a separation into laminæ of the iron, at this place, requiring the removal of part of the sheet.

68. While, then, the evidence in the cases preceding the last is certainly incomplete, the Committee conceive that they are leaning towards the side of safety by admitting the possibility of the occurrence of danger, to the engineer and fireman at least, from peculiarities in the arrangement of a boiler, or of the fire which heats it.

69. In these remarks it has been supposed that there is a considerable column of water over the metal; if that should not be the case it may well happen that the steam-bubbles will form so numerously on, or near, the iron as to allow it, while they rest there, to become heated above what it would be, if the water were in absolute contact with the metal.* This will especially occur with a viscid fluid, such as salt water, or water with much sediment suspended.

70. The views suggested by the several sections of the preceding head are the following:

* Replies, &c., No. II. Communication of "an Engineer." Philos. Mag. vol. i. p. 403.

1. The feeding of a steamboat boiler should not be done at intervals, but go on throughout the working of the engine.

When the engine is stopped, as at a landing, or to take up passengers, &c., the water should still be supplied by the engine itself, or by a subsidiary one, or by hand. In this case the free safety valve should be raised. The practice of wasting water by opening a valve, when the forcing-pump is not in action, is considered dangerous.

2. If the water should by any accident get down so as to expose a flue or flues, the fire should be in part extinguished, to cool the boiler before adding water. If the engine is at rest, in such a case, it should not be put in motion. If it is in motion it should be slackened, or stopped, the furnace doors opened, and the heat got down. Then water may be thrown in. The opening of a safety valve should in such a case be avoided. The engineer should remember that as life is at stake, he cannot be too prudent.

Such a condition of things, however, ought never to be allowed to occur, and the responsibility for the danger which results must rest upon the master, the engineer, and his assistants.

3. If a self-regulating apparatus for the supply of water is used it should be closely watched, and on no account be implicitly trusted to. It may be a convenience, but can, in no case, be a substitute for human care.

4. For ascertaining the level of the water within a boiler, the Committee recommend the glass tube water-gauge, a form of which is shown in the foregoing pages (p. 296).

5. The Committee recommend for every boiler a fusible metal apparatus, the metal of which shall be inclosed in a tube, so as not to expose it to pressure.

In boilers without flues it should be attached at the water-line; in those with flues, at the highest part of the flues; or if level, at the part likely to be most rapidly heated, as at the juncture of several flues into one, a sudden change of direction, or the place of most active combustion of the fire.

The form described in the report (pp. 297–298,) is convenient, and the lever should act upon a bell, and upon a small cock. The apparatus should be inclosed, the master of the steamboat having the key of the inclosure, which should further be so arranged as to protect the apparatus from the weather.

The quantity of metal should be no greater than is required to keep the rod in its place. The metal should be regulated so as to melt at a temperature of fifteen degrees* above that corresponding to the working pressure. Tables for this purpose, will be found annexed.†

* This difference of pressure corresponds at a pressure of two atmospheres, to half an atmosphere or one-half the bursting pressure, and at eleven atmospheres to rather more than two atmospheres, or one-fifth of the bursting pressure. The difference is not, however, too great at low pressures, because an excess of strength may rather be expected in the low pressure boilers as now made, and the alloys, containing bismuth, pass through the different states from solidity to liquidity, by slow degrees.

† While correcting the proof sheets of this No. of the Journal, we notice in the London Magazine of Popular Science, for last month, (September, 1836,) a paltry criticism of this proposition of the Committee—"to enclose the fusible metal in a case in which it shall not be exposed to the pressure of the steam, but only to its heating effect."—After quoting the sentence, the Magazine critic, triumphing in the fancied discovery of a good American bull, exclaims—"but *cui bono?*—for what purpose?—the metal is in a case! not exposed to the pressure of the steam! How then is it to act efficaciously as a means of relief to a boiler dangerously increasing in temperature? *How is it to act at all,* though fluid as in a crucible?" The conclusion he then arrives

If the metal is melted, the injection of water, or the opening of the furnace doors, will reduce the temperature of the heated parts; or lower the pressure of the steam if that should have been too high, and the safety valves be out of order.

By sounding with the rod, it will be ascertained when the metal is about to recongeal, as it becomes a soft solid into which the rod may be forced. If, accidentally, the metal congeals without taking in the rod, the end of the latter being heated, will melt the fusible alloy.

If the safety-valves do their duty, this metal will never be melted by increase of temperature, caused by an increase in the elastic force of the steam.

6. The true remedy for undue heating of boilers by deposites is frequently cleansing them. When this is impracticable, blowing out should be cautiously resorted to, so as not to lay the flues bare of water. The danger from these deposites is especially great in salt water, and muddy water mixed with calcareous matters. It should be guarded against by ascertaining the time required for the water used, to make a sensible deposite. No general rule in regard to this can be given, since boilers in different places and even those fed by springs at short distances apart are liable to deposites in different times.

Negligence on this point will always produce the rapid destruction of a boiler, and may cause it to burst, or even to explode.

No substitute for the care just recommended, has yet been found.

7. The following table of fusible alloys applicable to boilers working at pressures from one to thirteen atmospheres, is deduced from the experiments of the Committee.* The alloys are those determined approximately, which at temperatures severally 15° Fah. above the working temperatures will allow a metallic stem to be drawn out from the mass. The principles which guided the Committee in their experiments may be seen by referring to Part I. of their Report (p. 36, &c.) The proportions are given in parts by weight.

Table of alloys for use in closed tubes, and with a metallic stem.

Working pressure in atmospheres.	Tin.	Lead.	Bismuth.	Working pressure in atmospheres.	Tin.	Lead.	Bismuth.	Working pressure in atmospheres.	Tin.	Lead.	Working pressure in atmospheres.	Tin.	Lead.
$1\frac{1}{2}$	8	8	7.5	4	8	8	3.4	8	8	8	12	8	12.3
2	8	8	6.2	5	8	8	2.2	9	8	9.8	13	8	13.2
$2\frac{1}{2}$	8	8	5.3	6	8	8	1.2	10	8	10.6			
3	8	8	4.6	7	8	8	0.5	11	8	11.4			

(TO BE CONTINUED.)

at is,—"There must be a district in Pennsylvania where the Shamrock is worn"! And he further thinks, that our sage Committee would be likely to propose, as the best means of preventing the loss of a key which would alone open a box, to *shut it up in the box!* We recommend to this ingenious critic to read this part of the report of the Committee carefully over again, and try whether he can discover no good reason suggested for enclosing the fusible alloy in a tube,—and no substantial answer to his *cui bono?*—If his own vision should fail him, perhaps he will do us the favour to borrow that of some *intelligent* friend. We are not aware that the "Shamrock" is at all indigenous to this country, though we have thistles and thorns a plenty. G.

* Report of Com. on Expl. Part I. p. 36. Jour. Frank. Inst. vol. xvii. p. 86.

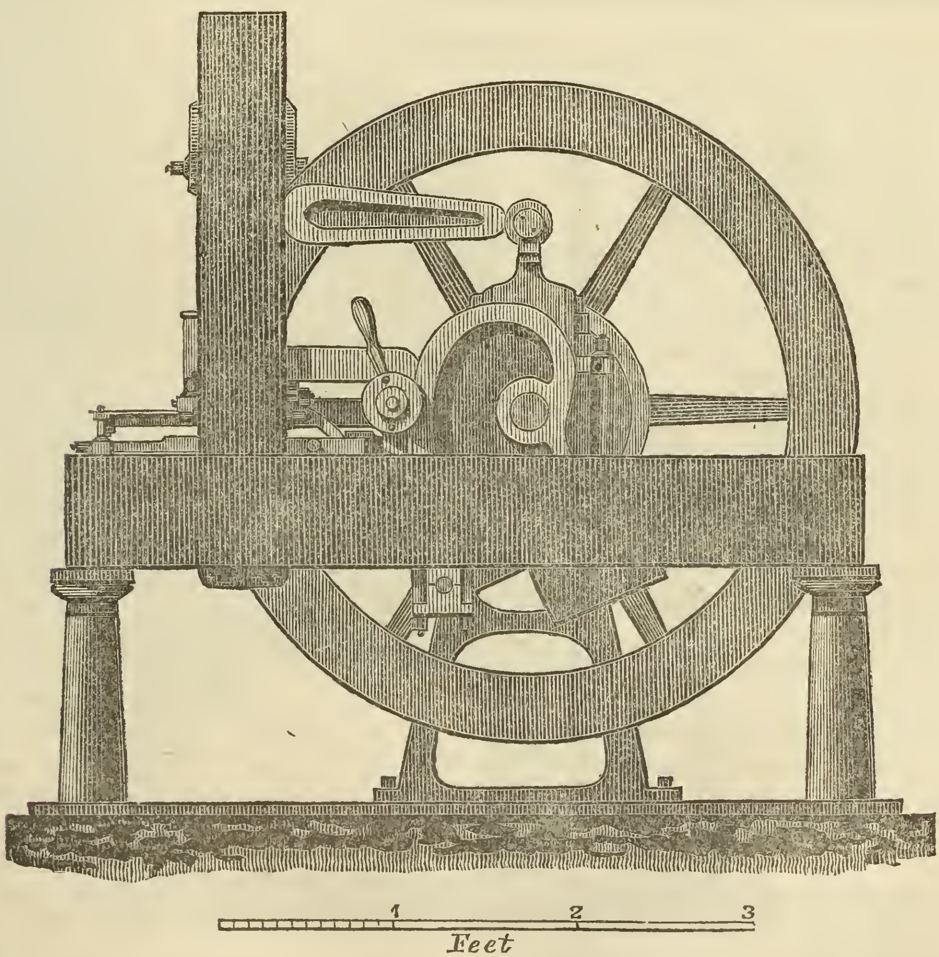
Description of the new Coining Presses lately introduced into the U. S. Mint, Philadelphia. By Franklin Peale, Esq.

TO THE COMMITTEE ON PUBLICATIONS.

Gentlemen:—After seven months of experience, it will not be considered premature, to send for publication, a brief notice of the Coining Press, a model of which I had the pleasure to exhibit and describe, at one of the Conversation Meetings at the Institute last year.

This press has been in operation since the 23rd of March last, the period of the first coinage by steam in the Mint of the United States; and the results, which are more than satisfactory, have authorized us to proceed with the most perfect confidence in the formation of the presses for the Branch Mints at New Orleans, and at Charlotte and Dahlonega, in North Carolina and Georgia; also, with the manufacture of others for the use of this Mint, all of which, it is probable, will be completed at an early period in the coming year.

Side view of the Press.



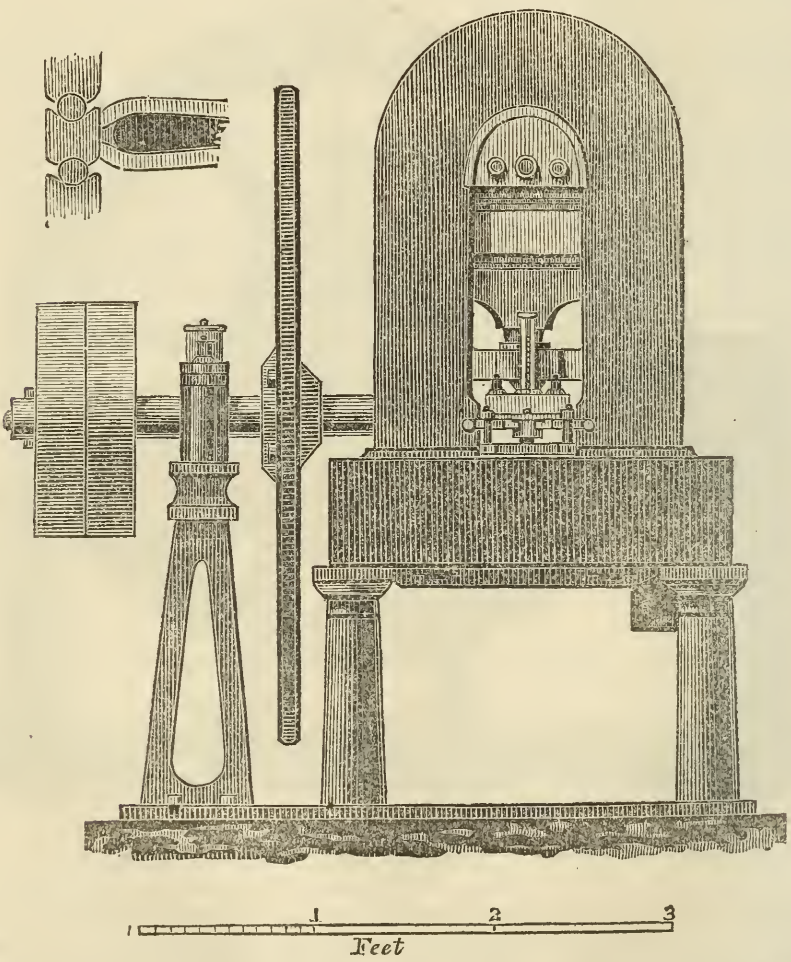
The above design exhibits a side view of the medium size press, intended to strike eagles, quarter dollars, and cents. Three grades have been adopted, corresponding in linear proportions to the numbers $9\frac{1}{2}$, 7 and 6, suited to all the denominations of our coin respectively.

The design exhibits the general proportions and arrangement of parts, consisting of a shaft with a fast and loose pulley to receive motion by means of a strap from the moving power, whether water, steam, horse, or hand:—

the latter, of course, being least desirable, will only be used, when neither of the others is available. Upon this shaft is placed the fly wheel, the momentum of which, during one revolution at the rate of sixty per minute, is found, on trial, to be quite sufficient to overcome the resistance offered by the piece whilst subjected to the pressure of the dies. Upon the same shaft is the crank, which gives motion, through the pitman, to a lever and toggle-joint, the structure of which is exhibited in the left upper corner of the front view presented in the next figure.

The feeding in of the blanks, or planchets, and their discharge after being struck, is performed by an eccentric and set of levers, all combined in so simple a manner, as to be effectual, and not subject to derangement; as much of these parts as are visible in the two views, are faithfully exhibited, but it is impossible to describe them intelligibly without the aid of drawings of the separate parts; and, further, since the drawings were executed, changes have been made in the position and form of the eccentric, by which the press has been much improved; a general notice is all that is intended in the present communication.

Front view.



The feeding tube is a vertical pipe to receive the blanks, in which they are placed by hand, and from which they are taken by the feeders; the latter are so arranged, that when a crooked, or otherwise faulty blank impedes the motion, (not an unfrequent occurrence in coining,) the whole

is immediately released from action, and will not again operate until the impediment be removed.

A few familiar facts are added as evidences of the peculiar adaptation of the toggle-joint to coining, as proved by the operation of the press which is the subject of this notice.

1. The pressure acts with increasing force until the close of the operation, at which time its intensity is greatest, and it is always carried to the same extent.

2. No injury occurs from the absence of a blank from between the dies when the blow is given, an accident that results in the destruction, or great injury, to one, if not both, of the dies, in presses of the ordinary construction.

3. An immense saving of labour. From trial, we have ascertained, that a man, with one hand applied by means of a common winch handle, can coin eighty pieces per minute, (the experiment was tried upon cents, which have a diameter of $1\frac{1}{10}$ inches,). A boy, fourteen years of age, was able to coin sixty per minute, without any unusual exertion; and lastly, it was impossible for the operator to tell, by the resistance offered to his exertions, whether the pieces were being coined or not.

It is by no means my wish to be considered the first who has applied the toggle-joint to the striking of coin. It is difficult to say to whom priority belongs; for presses on similar principles, are in use in more than one city of Germany, and their successful operation was witnessed at Carlesrhue, in the Grand Duchy of Baden. Particular advantage has also been derived from a careful examination of the coining presses of Monsieur Thonnellier of Paris. It is just to observe, that none of these presses were perfectly satisfactory. I have, therefore, made my own distribution and proportion of parts, thrown off whatever was complex, and added such as were necessary to its perfection, particularly, the arrangement for the disengagement of the feeders in case of the presence of defective pieces.

Our esteemed friend and fellow-citizen, Mr. M. W. Baldwin, several years since, commenced the construction of a press on similar principles. His talents and mechanical skill are amply sufficient for its completion; and it is to be regretted, therefore, that his numerous occupations have prevented his prosecution of the subject.

I take advantage of the present occasion, to make a few remarks on the application of steam power to coinage, as applied in the Royal Mint, on Tower-hill, London, which is one of the greatest curiosities in mechanics that I have ever seen, exhibiting consummate skill and great resources, on the part of the inventor, who, if I am not misinformed, was Mr. Boulton of Soho Works. For a series of years this machinery was kept rigidly secret; some even of the officers of the Mint not having the favour of seeing it accorded to them, and it might yet have remained so, if it were not for the advancement of liberal principles, which bid fair to keep pace with the rapid increase of mechanical ingenuity and skill.

The direct application of high steam to the screw press, would have answered every purpose, but still better, the substitution of the toggle-joint for the screw has rendered all this ingenious complexity unnecessary; but mechanicians may make their own inferences from the following sketch.

A low pressure engine, is employed to create a vacuum in a large *receiver*, (in this case a misnomer,) by means of an air pump, which serves as a reservoir of power, through the agency of which the pressure of the atmosphere, is exerted as occasion requires, both for the *blow* and *recoil* of the screw press, the former, produced by a cylinder and piston, furnished with valves, one of which opens to the reservoir, and the other to the exter-

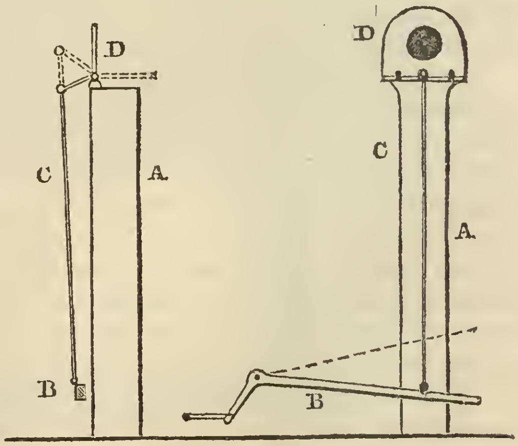
nal air, the latter, by a cylinder and piston, constantly acting, but with less power than the former. The valves are moved by levers which are struck at the proper time by a *plug frame* of similar construction to those employed in the ancient atmospheric engine. The power is communicated to the screw by tumbling shafts, connecting rods, and levers, the construction and operation of which could not be rendered intelligible without full drawings for reference. More words would, perhaps, render this brief notice as mysterious as the contrivance of which it treats; I will, therefore, close, by adding that eight of these systems, attached to eight screw presses, constitute the coining power of the British Mint.

On the management of Turn-outs on Rail Roads. By A. C. Jones, *Engineer.*

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Gentlemen:—At the present rapid rate of traveling on rail roads, it is a desideratum (in point of safety,) to know that the switches of the turn-outs are in the line of the road, so that the train is not necessitated to be much checked, in passing over them. The best method for insuring the right position of the switches, is that used on some short roads, by having a man stationed at them; but on long lines of road, where there are many turn-outs, this is not practised, owing to the expense attending it. As a substitute, a ball is placed on the end of the lever used to shift the switches, to show their position. This, I believe, is the best plan in use; that it is defective is proved by the numerous accidents occurring on rail roads by running off at the turn-outs, it not being foreseen that the switches are wrong. Where the turn-out is in, or at the end of a curve, it is difficult to tell by the ball how the turn-out stands, until you are so near as to make it impossible to stop in time, if it is not right.

The following arrangement will have a tendency to promote safety in this particular, and the additional expense will be but trifling. Instead of the ball, I propose having a board placed on the post, its face at right angles to the road, with hinges fastened to one edge, and from its face extends a short lever, which is connected to the lever that moves the turn-out, so that when the switches are changed, the dial, or board, takes either the horizontal or vertical position. This will be shown more fully by an inspection of the cuts.



On a curve or grade, this method would have the same advantages as on a straight part of the road, and it is evident, the face or edge being presented to the engineer, that he will be thereby enabled to judge how the turn-out stands, at a greater distance from it, than by the method in practice, and will consequently admit of his stopping the train in time to prevent accidents.

A. The post. B. The lever. C. Connecting rod. D. Dial.

Respectfully, yours,

Philadelphia, Sept. 1836. A. C. Jones.

This appears to be a good suggestion. A board, or disk, with a black circle in the centre, surrounded by a broad white border, would be more

conspicuous, and its position, in the way proposed, more easily perceived than the ball now in use. In turn-outs that are much used, it may be expedient to keep a lamp burning during the night, to show the position of the disk. It seems desirable, however, that every precaution should be taken to prevent the necessity of stopping a locomotive train in order to adjust the switches of a turn-out. J. G.

Franklin Institute.

Committee on Science and the Arts.

Report on Mr. C. Kenzie's Water Wheel.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination the model of a Water Wheel, invented by Mr. C. Kenzie, of Troy, New York, REPORT:—

That they have carefully examined the object submitted to them, and find that it is a modification of the tub and the undershot wheel. The peculiarity of the invention consists in receiving the water from a number of chutes at once, distributed around the periphery of the wheel. The buckets or float-boards, are set in the direction of the radii, and the water is directed as nearly as practicable in the line of a tangent to each float. In this arrangement the water is, of necessity, discharged from the wheel within the rim, or shrouding, and is allowed a free escape on both sides of the wheel. The wheel is placed in a horizontal position, at the bottom of the fall, entirely under water, and is surrounded by a box or tank of an equal depth with the wheel, to which it is accurately fitted to prevent the escape of water between them, whilst it permits the latter to revolve freely.

The supply of water is through a water-tight trunk connected with the tank, by which the entire head and fall is made available, the wheel being sunk below the lower level as before stated.

One of the benefits arising from this arrangement, is that of the water being received on the wheel in a compact form, owing to the spaces being kept always full by the centrifugal force. A principal advantage, however, is that of being able to employ a much greater quantity of water than could be brought to bear upon the floats by any other wheel of equal size.

The Committee believe that the advantages above enumerated, are in accordance with the principles of hydrodynamics, and that its inventor has attained a high degree of perfection in that description of wheel, and they are happy to add, that so far as their knowledge extends, the arrangement is new.

The Committee take leave to suggest, that since the water always retains a part of its power, proportionate to the square of its velocity, on leaving the wheel, no inconsiderable portion of it would be saved in this instance by extending the buckets to the centre, so as to deliver the water at as low a velocity as possible; and they would also recommend the use of a partition which should cause all the water to take the same course in the floats. In this case the rim must of course be made wider so as to contract the diameter of the opening to what would be just sufficient for a free delivery of the water.

By order of the committee.

Oct. 13, 1836. William Hamilton, *Actuary.*

Report on Mr. Holcomb's Reflecting Telescope.

The Committee on Science and the Arts, constituted by the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, to whom was referred for examination a Reflecting Telescope, made by Mr. Amasa Holcomb, of Southwick, Massachusetts, for the Newark College, Delaware, REPORT:—

That the following description of the instrument is given by Mr. Holcomb: "The telescope submitted to the examination of the Committee is a Reflector on the plan of Sir Wm. Herchel. It is fourteen feet long and ten inches in diameter. It has six different magnifying powers from 70 to 1000."

The Committee proceeded to the examination of the telescope on the evening of the 17th instant. A trial was made of its various powers from 70 to 1000, upon the moon, upon several nebulæ, clusters, and double stars, and they beg leave to report as the result of that examination, that the instrument possesses all the superiority over any reflectors hitherto submitted by Mr. Holcomb, which its increased length and aperture would lead us to expect, and that it has every attribute of excellence which the best optical skill could give to an instrument of these dimensions. The Committee cannot forbear again commenting upon the excellence and simplicity of Mr. Holcomb's method of mounting the instrument, which notwithstanding its size, is portable, with all its mounting, by a single person. The object is easily followed by the rack work and the inconvenience from the motion of carriages at short distances from it, was not found to be greater with a power of 1000, than with a power of 100, in the common mode of mounting achromatics, moveable by rack work on an upright stand.

The short time allowed the Committee prevented them from making observations on close double stars, for the purpose of determining the limit of its optical capacity. All of which is respectfully submitted.

By order of the committee.

Oct. 13, 1836. William Hamilton, *Actuary.*

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1836.

With Remarks and Exemplifications by the Editor.

1. For a machine for *making and Cutting Crackers;* William R. Nevins, city of New York, March 2.

A claim is made to "the peculiar arrangement of the machinery as described, by which the operation of the rolling of the dough, and cutting the biscuit, or crackers, is performed at the same time and with the same machine. Also, as an improvement, the horizontal rack or pinion by which motion is given to the cutters."

The description of the machine is very imperfect, and the drawing lends but little aid in exhibiting the "peculiar arrangement" of its parts. There are to be two, or more, pairs of rollers to roll out the dough; a moveable table, or apron, to carry it under the cutters, and the frame carrying these cutters is to be raised, we believe, by cams, or lifters, and is to fall by its own gravity. There are many other machines in which the rolling and cutting are performed at the same time, this, in fact, is common to the numerous instruments which have been contrived for making crackers.

2. For a *Power Printing Press;* Isaac Adams, city of Boston, Massachusetts, March 2.

We cannot attempt to give any description of this press, the specification of which occupies sixteen pages, with numerous references to the drawings; the claims amount to twenty-one in number, and it will be a fortunate, and very remarkable, circumstance, should the whole of them prove tenable. The press has been tried, and we are informed that it operates well, and is much superior to that patented by the same gentleman, which was itself a good one. The combinations in the present instance are sufficiently novel and characteristic to render it unnecessary to resort to minute particulars in the claims, a course which is commonly pregnant with danger; if one thing only that is essential to the existence of a machine is claimed, it is safe to trust to this alone. In the case before us, we could point out more than one thing claimed which is not new, and the patentee himself informs us respecting one of them, that "the claim last above written, on the nippers, is not to extend to cylinder printing machines;" a court and jury, we apprehend, would not regard such a limitation.

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3. For a *Stove for Cooking and Warming Rooms;* Foster Stevens, Springfield, Hampden county, Massachusetts, March 2.

The general form of this stove, as represented, is that of the common Franklin, or open, stove; but in this form it is to be used for heating only; when employed for cooking, a close, or box, fire place, is produced by means of two plates hinged together, and folding up against the back of the stove; one of them, when unfolded, forms the top of the close stove, and has perforations for cooking utensils; the other makes the front, and has folding doors to supply the fire. There are wing plates, which when not used to complete the enclosure, fold against the sides of the stove.

The claim is to "the combining the cooking stove with the common fire place, or fire frame, by means of the folding plates and wings, and the closing of the lower flue by means of the plate when folded back, so as to cause the smoke and heat to pass off as in a common fire place."

Such folding plates are apt to be troublesome, and are liable to get out of order, by warping from heat, the insinuation of ashes, &c. about the joints. Should there be no difficulty of this kind, we are not aware of any thing which will interfere with the claims of the patentee.

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4. For *Apparatus for heating buildings, and for Cooking;* Lovell Lewis, Lewiston, Niagara county, New York, March 2.

A stove of any of the usual kinds is to be employed for the combustion of the fuel, and this is to be surrounded by a casing of tin, allowing a space between them; the stove pipe is to be surrounded in the same way by a tin case, which is to be closed at top. From this casing tubes are to lead into any part of a building to be heated; and when cooking is to be performed, the articles to be operated on are placed within the casing, which is furnished with doors for that purpose. The claim is to "the method, or manner of collecting, retaining, conducting, and using, heat, for the purpose aforesaid."

Although we have good and bad conductors, and good and bad radiators of heat, we cannot by any of our devices, bottle up, and retain this subtile medium, as we can bottle up and retain water; neither will it, at our bidding, pass through tubes, or be drawn off by pumps and cocks, in the manner of

liquids. But apart from this, the foregoing description sets forth no new discovery, as tin cases to stoves and furnaces intended to arrest and retain the heat, are well known devices, and have been made the subject of patents in various instances.

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5. For a *Washing machine;* John O. Geer, Norwich, Connecticut, March 2.

A cylindrical barrel is to be placed horizontally, and within it are to be revolving dashers. "The construction of the inside movements, and the operating of the same," constitute the claim.

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6. For a *Safe for protecting account books, &c. from destruction by fire;* Daniel Harrington, city of Philadelphia, March 2.

A firm enclosure is to be built of brick, or stone, extending from the cellar up to the floor of the apartment in which the safe is to be used. The safe itself may be made of wood, and is to be suspended by pulleys and a counter weight; sliding and folding doors of iron shut down over the safe, when it descends into the fire proof case, or well; these being of sufficient strength to prevent any danger from walls, or rubbish, falling upon them, and being so contrived as to be, to a certain extent, self-acting, covering the safe as it descends. The particular devices we cannot take time to explain, but think them such as are well calculated to answer the purpose intended.

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7. For *Cutting and forming heads for barrels, &c.;* Hiram Andrews, Canaan, Litchfield county, Connecticut, March 2.

Various machines are in use for cutting heading for casks, &c., but that described in the specification of this patent appears to be sufficiently new to justify a claim to invention. The heading is to be cut rounding by means of a concave, circular saw on a revolving shaft, within which saw there is a circular cutter, of somewhat less diameter than the saw, and in contact with it, furnished with teeth so formed as to give the proper bevel to one side of the head. A similar cutter on another shaft bevels the opposite side of the head, the latter being properly secured on a revolving platform, operating as a chuck. The drawing is very indifferently executed, affording but a general idea of the machinery, and is, therefore, not such as the law requires. The specification affords a good general description, but no more; and the claim is to "the combination of the several parts of the machine, and the placing them in the position which effects the object of cutting and forming heads for any casks of any dimensions." Such a claim we do not think good, as it does not designate any particular combinations, as characteristic of the machine, whilst several of the things combined, have been similarly arranged in other machines, for the same, or other purposes.

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8. For a *Self-sharpening pick for dressing mill stones;* Samuel Etheridge, Tecumseh, Lenawa county, Michigan, March 2.

This invention is claimed as applicable to stone hammers, as well as to picks for mill stones. The hammer, or pick, consists of two pieces of iron, embracing a plate of steel between them; to one of these pieces the handle is fastened, by passing through it in the usual way, and against this the other piece, or jaw, is to be forced by means of a wedge, so as to hold the steel plate firmly.

Claim. "What I claim as my invention, and not previously known, in the above described pick axe, and chisel, is the making of the point or cutting part a separate and distinct piece from the body; the manner of holding it between two jaws held together by a strap, with the key, or a screw; the manner of sliding it down and fastening so that it will not drive back again; and the making of the point of one thickness of steel between two of iron welded together, so that the iron will wear off faster than the steel, and thus constitute a self-sharpening point."

By turning to page 25, vol. xvi., it will be seen that the first member of the foregoing claim is in terms which cannot be sustained.

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9. For an *Instrument for perforating Wood;* John B. Pell, city of New York, March 2.

This perforating instrument consists of a cylindrical steel tube, well polished within and without; it has at one end a cutting lip, and, if preferred, an entering screw, and at the other there may be a handle like that of an auger. The tube is somewhat smaller at the cutting than at the handle end, and the chips which pass into it are, consequently, not obstructed in their passage through it. Besides the perforating instrument, the specification describes and claims a machine for working and directing it, by means of a guide screw, and other appendages.

Claim. "What I claim is, first, the tube perforator which casts its cuttings through the tube or heart of the instrument, and bores without clogging with its own cuttings; and, secondly, the labour saving machine for giving a rotary motion to the perforator, more advantageously than by a handle worked in the manner of a common auger."

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10. For an improvement in *Piano Fortes;* Isaiah Clark, Cincinnati, Hamilton county, Ohio, March 2.

The patentee states that he makes an entire and distinct frame of iron, which frame is to bear the whole strain of the wire, or strings, and claims "the entire iron frame, made of cast or wrought iron, or any other suitable metal; also the sounding board, on account of its being attached to the said frame; and also the peculiar direction of the treble strings." The treble strings are nearly at right angles with those of the bass.

We did not suppose that there existed a single piano forte maker who was unacquainted with the fact that pianos had been made with *entire iron frames*, in France, England, and the United States; it appears, however, that we were mistaken.

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11. For a *Brick Press;* Phineas Ball, Mount Vernon, Knox county, Ohio, March 2.

This machine is intended for pressing untempered clay by what is denominated the double-actioned joint levers; the main point depended upon appears to be the pressing of the brick clay in the mould by a follower on each side of it, one working up, and the other down. The general construction of the machine is shown in the drawing, but there are several particulars not so explained as to enable a workman to construct a complete machine. The claim is certainly broader than the invention; it is to the giving to the levers that double action which causes the material to receive an equal pressure from above and below; and also the invention of pressing the brick on the edge, or face; likewise the improvement in the art of making brick by pressing untempered clay; together with the general com-

bination and arrangement of the respective parts, as herein described, by which this machine is distinguished from all others constructed for the same purpose."

We are confident that bricks have been pressed by double followers in machines previously made, and there are numerous patents for making brick by pressing untempered clay.

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12. For *Forge furnaces, and steam engine boilers, in combination;* Alexander Harrison, New Haven, Connecticut, March 2.

The body of this combined forge and furnace is represented as nearly egg-shaped; into the lower part, or air chamber, the wind is to be forced, and is to pass up through a grate upon which the fuel lies; the furnace, or forge, occupying the middle portion of the apparatus; into this part there are several openings, or doors, giving access to the fire; the upper part of the egg-formed body constitutes the boiler, which in part, also, surrounds the fire.

The claim is to the "combination of a steam engine boiler with a forge furnace, constructed substantially as aforesaid; that is, with a boiler so formed as to constitute the sides and top of the forge furnace."

There are several things alluded to, which are not explained; the use and application of the apparatus are also very vaguely presented.

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13. For a *Saw mill dog, or carriage stock;* Jesse Reed, Marshfield, Plymouth county, Massachusetts, March 2.

Various modes of forming dogs for holding, and slides for setting, the logs on saw mill carriages, have been made the subject of patents. The things claimed by the present patentee, are a "notched slider, a hand, weight and lever, a lock joint of a knee, a swivel brace, right angled dogs, and the method of confining them, as described, with their arrangement." Some of the parts individually claimed are not new; as, for example, the *notched slider*, which is a bar of iron forming a rack on its lower edge, and having the right angled dogs on its upper side. The notches, or teeth, on the lower side of the slider, are for setting the log, which is to be effected by the running back of the carriage, in a manner very similar to that adopted by Phineas Bennett. The mode of action is not exhibited sufficiently in detail, to instruct a workman, we cannot, therefore, speak with confidence respecting its originality.

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14. For an improvement in the *Axles of wagons, carriages, &c.;* Spencer Coleman, Mount Pleasant, Spottsylvania county, Virginia, March 2.

These axles are called rolling axles, and from the description it appears that they are so denominated from the whole axle being allowed to revolve in boxes fixed on the bolster, or other suitable part, of the frame of the carriage; whether the wheels are also to revolve freely on the axles we are not told, but suppose that they are, otherwise there would be a difficulty in turning the carriage. There is not any claim made, and the patentee is in error in supposing, as he must, that the revolution of the whole axle is a novelty.

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15. For a *machine for breaking dough, for making bread;* Daniel

D. Shackford, and Theodore Shackford, Westbrook, Cumberland county, Maine, March 2.

A circular platform, surrounded by a curb, or rim, converting it into a shallow tube, or trough, is made to revolve horizontally by suitable gearing; within this the dough to be broken is placed, and is operated on by a fluted frustrum of a cone which presses upon it; this frustrum has projecting axes which are suspended by a rope, or chain, from the upper part of the frame of the machine, allowing it to roll freely, and to adapt itself to the surface of the dough. The claim is to "the combination and arrangement of the foregoing machine for breaking dough."

Machines nearly identical with this have been used for washing clothes.

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16. For *Rotary stove caps;* Maynard French, city of Albany, New York, March 2.

According to our understanding of the description of these rotary caps, or tops, of cooking stoves, they differ from those used in Stanley's well known rotary stove in being elevated three, or more inches above the upper fixed plate of the stove, by a circular rim, all around the cap, there being divisions, or descending partitions, on the under side of the cap, between the different openings for cooking utensils; this arrangement being substituted for the circular rim surrounding each opening on the upper side of Stanley's stove cap. The claim made is to "the elevation of the cap, or caps; the formation of the chambers by the various partitions on the under side of the cap or caps; the methods of conveying the smoke and heat from chamber to chamber; [by openings in the partitions,] and the adaptation and application of the said caps to stoves and furnaces, as above described." We see no essential difference between these caps, and those used by Stanley; nor any superior advantage to be derived from them.

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17. For an improved machine for *Renovating and purifying Feathers;* John W. Post, and Ralph Collier, city of Baltimore, March 2.

Two plans of operation are here proposed; one of them is to put the feathers into a double cased vessel, provided with agitators to stir them up; they are to be heated by admitting steam from a boiler between the two cases, so that it may not come into contact with the feathers. The second plan is to dress the feathers without taking them out of the bed; an opening is to be made through the tick at one end, and a recurved metallic tube is to be inserted, through which steam and heated air are to be passed, the bed being occasionally shaken during the operation.

The claim is to "the apparatus as above constructed, and particularly the introduction of heat into beds, without taking out the feathers."

We do not believe that either of these plans will be so effectual as those in which moisture is allowed to come in contact with the feathers, and as respects that *particularly* claimed, we are convinced it will be productive of little, or no, benefit.

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18. For a *Churn;* Amos Hanson, Windham, Cumberland county Maine, March 2.

The cream is to be put into a square box with a curved bottom, and to be agitated by means of revolving *ladle boards*, or dashers, which are to be

moved by a cog wheel and pinion. The claim is to "the gearing that is attached, and that operate said machine"!!

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19. For an improvement in the *Printing Press;* John L. Kingsley, city of New York. First patented, April 22, 1835. Surrendered and reissued March 2nd, 1836.

We remarked upon this press as originally patented, at p. 328, vol. xvi. and noticed the defectiveness of the claims made; these are now in the following words: "What I claim as my own original invention in the machinery, is the universal joint of the ball in two sockets; the double joints of the connecting rod, roller, and standards; the manner of regulating power by the screw die and binding nut; and also to the lever, and its manner of connexion."

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20. For a machinery for *Making Gauges for cabinet makers and joiners;* Morris M. Brainard, Great Barrington, Berkshire county, Massachusetts, March 4.

This machinery consists of a socket chisel for boring and mortising the heads; of a grooving drill, or cutter, for grooving the bar to receive the slide; of a sliding scraper for fitting the slide to the groove; of a burr saw for dressing the gauge bar; and of a revolving shaver for finishing the head of the gauge, and bringing it into proper shape. Most of these are revolving cutters used in the lathe, and adapted in form to the purpose for which they are intended, but not possessing any of that kind of novelty which would class them among inventions. They can hardly be said to be described, yet it would be easy to make similar tools by referring to the drawings, not from the special clearness of these, but from a familiarity with similar articles.

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21. For a *Composition of Pitch;* Thomas H. Sherman, Scriba, Oswego county, New York, March 4.

To make this composition, twenty-five pounds of water lime, and eight and one-third pounds of salt are to be added to 100 pounds of common pitch; the lime is to be added first, then the salt, "and all the process is to be effected over a moderate fire. This gives a substance superior to common pitch, inasmuch as it is harder in the water, and wherever placed remains permanent."

The foregoing comprises the entire substance of the specification, in which there is not any claim made. We have known lime and salt added to tar, and the whole boiled together, which, we apprehend, produces a result the same with that of the foregoing recipe. This composition we have seen employed with good effect, for covering shingled roofs. Sparks falling upon it are not so likely to produce combustion as upon dry shingles.

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22. For *Applying Plaster of Paris, in forming Walls, &c.;* John Flint, city of New York, and Clark Mills, Syracuse, Onondaga county, New York, March 4.

A main object of this patent is to secure the right of using "plaster to form walls to obstruct the influx of water in pits where reservoirs are to be built." After digging the pit, plaster is to be sifted, or poured, into the water which is contained in it, so as to cover the bottom to the thickness of four or five inches; a suitable curb is then to be inserted, leaving a space of two or three inches between it and the walls of the pit, which space is to

be filled with plaster; the curb, and any contained water, are then to be removed, and the plaster covered with a coating of hydraulic cement. Reservoirs in grounds free from water, and also above ground, are to be formed on similar principles, instructions for doing which are given in the specification.

The things claimed, are the use of calcined plaster, either alone or mixed with other materials, for making walls, or guards, to obstruct the influx of water, in places where such influx occurs; also the use of the like materials for forming other cisterns, to contain liquids.

Hydraulic cement, without the intervention of Plaster of Paris, has been used in a similar way, for the same purpose, and we cannot perceive the advantage of using both. With respect to the claim above made, we do not think it tenable, as it does not contain any new discovery, or mode of procedure, or point to any "new machine, art, manufacture, or composition of matter."

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23. For an improvement in *Locks and Keys denominated the Lever Lock and Key;* Augustus Prutzmann, city of Philadelphia, March 4.

A report upon this lock will be found at page 180; it having been submitted to the Committee on Science and the Arts. We cannot do better than refer to their report, as any attempt at description, without several drawings, would give a very imperfect idea of the construction of the locks. We have not looked enough into it to form a satisfactory opinion of its relative merits.

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24. For an improvement in *Rail Road Cars;* Frederick Davis and William Ashdown, Baltimore, Maryland, March 4.

This is said to be an improvement upon the plan patented by G. W. Cleaveland, on the 14th October, 1835, in which axles, divided in the middle, were employed in what was called a self-adjusting rail road car. The present patentees adopt the divided axle, each wheel turning independently, and being connected by a system of levers by which they propose to adapt the wheels to the curvature of the road, whatever that may be, and thus to prevent the vibrating, or zig zag, motion of the car, and preserve the flanch from contact with the rail. It so happens, however, that this vibratory motion is not caused by the curvature of the road, as it takes place as strikingly in the straight parts, and results from those perpetually recurring inequalities, which are unavoidable even on the best roads. The same defect attends the proposed plan as that which we have noticed in some others, namely, the fore and hind wheels are simultaneously acted upon; yet it must happen at the beginning and the end of every curve, that one pair of wheels will be on the curve, whilst the other pair is on the straight rails.

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25. For a *Water Wheel;* Frederick Wingate, Augusta, Kennebec county, Maine, March 4.

The patentee intends to use this wheel, for "propelling mills, machinery of any kind, boats and vessels, by water power." Since obtaining his patent he has had time to try this wheel, and if he has done so, we are convinced that it is like many other things on trial, in the way of condemnation. The wheel is made in the manner of the common smoke-jack, consisting of a circular disk cut into six, or any other convenient number of, sections, by radial lines from the periphery towards the centre, and setting the sections

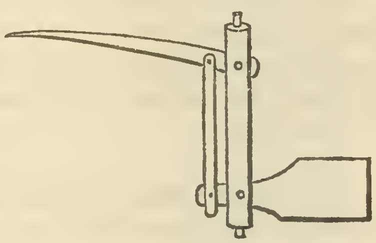
somewhat obliquely. Such wheels have been frequently tried, but not a second time, we apprehend, by the same person. They were essayed for propelling on the Hudson, by Gen. Stevenson, more than thirty years ago.

26. For an improvement in the *Bar-share Plough;* William P. Cannon, Monroe county, Tennessee, March 4.

Claim. "What I claim as my invention, and not previously known, in the above described plough, is the mortise, heel plate, and screw, on the horizontal bar, allowing the plough to be regulated in the depth by turning on the heel screw, instead of the eye or rachet, which rendered the plough stationary as to depth, unless through the alteration of the horses' hames. And in discovering the property, and first making of the mortice in the upright, or perpendicular bar, so as to fix the plough at any depth desirable by the movable rivet."

27. For an improvement in the *Rudders for Ships and Boats;* Samuel Kepner, Harrisburg, Dauphin county, Pennsylvania, March 4.

Ships need not to have been mentioned, as this rudder will never be applied to them; it has been contrived for canal boats, and may possibly answer a good purpose in such vessels. The sketch in the margin will give a correct idea of the thing proposed, which is so to construct the rudder that by depressing the tiller, it will be raised out of the water, in which case it may be made to operate like an oar, enabling the helmsman the more readily to govern the boat.



28. For a machine for *Turning Boots;* Pelatiah Stevens, Jr., Stoughton, Norfolk county, Massachusetts, March 4.

We described a machine for turning boots at p. 266, vol. xvii, which undoubtedly answered the purpose perfectly well. The plan now proposed bears a strong resemblance to the above; the present patentee, however, states that he contrived his and put it into operation, prior to July, 1833. We are apprehensive that this statement will not aid him in sustaining his patent, as a public use of it for two or three years would abstract something from its novelty.

29. For an improvement in the *Printing Press;* Hezekiah Camp, Trenton, Tuscarawas county, Ohio, March 4.

This is called a *flexible tympan press;* and it is so called because the tympan, with the sheet upon it, is drawn down under a press roller, to receive the impression. A claim is made to the manner of throwing this press roller in and out of gear; also to the flexible tympan, self-operating clamps, &c. The drawing is not sufficiently in detail to show the construction of the various parts; and the flexible tympan, which is broadly claimed, is not new.

30. For an improvement in the *Steam Engine;* Nathan Lockling, Sparta, Lexington county, New York, March 4.

This improvement is, to us, truly transcendental; or, in other words, we

are unable to follow out the intention of the inventor, even with the aid of a well executed drawing. The furnace is within the boiler, and it is proposed to return the smoke and the escape steam back again through the furnace. To effect this object the flue from the furnace enters a drum, or case, furnished with a revolving fan, which is to drive the smoke, &c. &c., through a tube leading down behind, and under, the boilers, through which it passes, opening under the burning fuel. We see nothing to prevent a perpetual circulation of the same products of combustion. Besides this smoke pipe from the furnace, a steam pipe enters the above named casing, directly from the boiler, and is, in the drawing, called an escape pipe, and steam will certainly escape though it, but not that which we usually understand by the term escape steam. "We give it up."

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31. For *Cotton Gin Grates;* Edwin Keith, Bridgewater, county of Plymouth, Massachusetts, March 4.

This patent is taken for making the grates of cotton gins of chilled cast-iron. The method generally preferred, is to form the slots in the grates by laying plates of iron in the flasks when casting, which chills the parts where the saws operate; sometimes, however, the whole face of the grate is to be chilled. The claim is to "the making of grates for cotton gins of cast-iron, or other fusible metal suitable for the purpose, in sheets of two, or more, connected at the ends; and of chilling them either in the whole or in part, as described."

What "other fusible metal" is suitable for the purpose, we do not know; these words, it is true, will do no harm, but they are unmeaning, and intended to guard against some airy nothing.

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32. For an improvement in the *Plough;* David Prouty, and John Mears, Boston, Massachusetts, March 4.

The claims made consist, "First, in the inclining the land side, so as to form an acute angle with the plane of the shear. Second, the placing the beam on a line parallel to the land side, within the body of the plough, and its centre nearly in the perpendicular of the centre of resistance. Third, the forming of the top of the standard for brace and draught." These points, it is stated, are not claimed separately, but in combination with each other. This plough, we are informed, has been highly approved by those farmers who have used it.

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33. For an *Open Screw Wheel for propelling steam canal boats;* Aretus A. Wilder, Warsaw, Genessee county, New York, March 8.

The open screw wheel is to be made by floats upon a long shaft, forming an interrupted spiral; and this is claimed, with its application to the propelling of steam, canal, and other boats. If there were any novelty in this contrivance, we might descant upon its merits; but the patentee might find upon the shelves of the Patent Office, models of such wheels, long covered with the accumulating dust of years; much longer, we are fully convinced, than he will have them covered with water.

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34. For a *Double Force Pump;* Levi Newton, Alexander, Genessee county, New York, March 8.

As usual, in patents for pumps, there is nothing new in that before us. Two chambers, or cylinders, are placed in a well, and a brake carrying

two piston rods, works the two pistons, and forces the water up through a common pipe.

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35. For a *Splint for reducing fractures, called a sliding metallic Splint;* Enoch Thomas, New Athens, Morrison county, Ohio, March 8.

This splint is capable of being lengthened, or shortened, to adapt it to persons of different heights. We shall not attempt to describe the particular construction of any of its individual parts, as these do not constitute any part of the claim, although they are dilated upon in the specification. The claim is to "the combination, arrangement, and adaptation of the several parts of the splint, as described." A claim, which, like the splint itself, is calculated equally well to fit every subject.

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36. For a *Smut machine;* Marcus P. Spafford, Gainsville, Genessee county, New York, March 8.

A conical body is to revolve within a conical case, as in many other smut machines. Both the exterior of the runner, and the interior of the case are to be first covered with sheet-iron, and then with sole leather, and through these coverings iron teeth are to be driven, cut nails answering the purpose. A fan-wheel is employed to blow through between the runner and the case, so as to drive the separated smut, &c., entirely away. A second fan-wheel below the machine is to effect the final cleaning. The patentee says that he "does not claim any part of the above construction other than the combination of the leather and sheet-iron, to retain the teeth, and in separating smut from grain, so as that they shall be immovable; and also the adaptation of the fan on the top of the cone to produce a current of air downwards through the teeth."

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37. For *Leaching ashes, and making salts for Pearlash;* Elijah Williams, Erie, Erie county, Pennsylvania, March 8.

The instructions are to boil crude ashes in weak lye, or water, over a brisk fire, for about twenty minutes, the weak lye, or water, and the ashes, being in about equal proportions; this is to be let into the leach during the effervescence. The boiled ashes to be leached about eight inches in depth in the trough, boiling hot weak lye to be first used, and then boiling hot water. The lye is then to be boiled down in the usual manner.

The boiler should be made of sheet-iron, or copper, with a flat bottom, about three feet wide, and eight long, and twenty inches deep. The leaches to be of wood, with a flat bottom, and having a straw strainer, with a tube below for letting off the lye. Lye obtained by this process, and put through a lime strainer, will make good salts for melting. The claim is to "the boiling and leaching ashes, as above, without the use of lime, and making salts suitable for pearlash."

The above is the whole substance of the specification, if substance it have. To us, however, it is altogether obscure and indefinite.

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38. For an improvement in the method of *Making Mould Candles;* Jefferson Dunlap, Village of New Holland, Lancaster county, Pennsylvania, March 8.

This is an apparatus for passing the wicks into the moulds, giving them the proper twist, and drawing the candles simultaneously from the moulds,

The machine appears to be well adapted to the purpose, but would require more than a verbal description. The whole arrangement is claimed.

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39. For a *Brick making machine;* John Moffet, Buffaloe, Erie county, Pennsylvania, March 8.

In this machine the bricks are to be pressed into moulds by the passing over them a loaded car, or carriage, beneath which is a pressing roller, extending the length of the brick. The moulds are placed side by side, in any required number, so as to form a long trough of cells. Parallel to this celled trough, a second is placed at a suitable distance from it, and semicircular platforms are made at each end, so that the whole may form a continuous railway, admitting of the car to pass round and round. The moulds are to be filled with tempered clay, and the loaded car passed over them, which fills them and smooths the upper surface of the brick. The bottom of each mould is capable of being raised up so as to deliver the brick; and to effect this, from each of these bottoms the end of a lever projects, which is acted upon by a lifter on the hind wheel of the pressing car, in a way described in the specification. The claim is to "the adaptation of the car and rail road to the manufacture of bricks, as set forth; and to the manner of raising the bricks out of the moulds."

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40. For the *Application of latent heat to cooking, &c.;* Peter Wenn, an alien, who has declared his intention to become a citizen of the United States. Philadelphia, March 8.

It is a little surprising that a patent should be obtained for a contrivance so manifestly useless in an economical point of view, as it is scarcely to be expected that any number of persons would purchase what few would receive as a gift, on the condition that they should use it. Passing over the false philosophy of boiling, &c. by latent heat, we proceed to state that the apparatus consists of a tin case, into the lower part of which quick lime is to be put, and upon this cold water is to be allowed to run, when, by the slacking of the lime, a sufficient degree of heat is to be disengaged to boil, stew, &c. &c. The claim "is to boil water, to bake, heat, cook, and to dry substances *by means of latent heat*, evolved in the before described apparatus, without the aid of fire, flame, or radiant heat; and the manner in which the apparatus is to be used as aforesaid."

As a mere article of curiosity the thing was well enough, though scarcely fit for a "nine days' wonder." The idea of laying in quick lime enough for fuel, of discharging and vending the slacked lime, with all their concomitants, is one which no person, possessing judgment upon the subject, would entertain for a moment; and we dare aver that the patentee would not continue to use his own apparatus in his family, were the lime sent to him gratis.

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41. For a *Steam boiler;* Job Carr, Springborough, Warren county, Ohio, March 12.

This boiler is intended to "generate a sufficient quantity of steam for propelling any kind of machinery, without any danger of bursting or collapsing." And a claim is made to the construction of the reservoir and furnaces, or improved steam generator, and agreement of the combined parts." What is meant by the *agreement of the combined parts*, we cannot tell, as we find nothing new in the whole affair, either individually, or collectively. The only provision to prevent bursting is staybolting through

the boiler, and banding it with iron on the outside. The boiler itself is to be wagon-shaped, and the furnaces are to be within it. We collect from the description, that in order to generate steam enough, there must be fire enough, and water enough, but more than this we cannot discover.

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42. For a *Washing machine;* Albion P. Arnold, Readfield, Kennebec county, Maine, March 12.

A double headed beater is made to vibrate in a trough in just the same way as in many other washing machines; and after giving the exact measures of the individual parts, the patentee claims "the fluted ends of the chest, the covering, the iron shaft and boxes, the steel spring and the lever on which it acts," to which might have been added "the washerwoman," if not previously claimed.

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43. For a *Forcing pump;* William W. Lesuer, Venice, Cayuga county, New York, March 12.

This is a double, cylinder pump, arranged very much in the manner of the double pumps of an ordinary fire engine, with the disadvantage, however, of changing the direction of the water as frequently, and as abruptly as could well be done. A tube, or pipe, is to descend from the bottom of the box containing the cylinders, into the well, or other source of supply. A claim is made to "the tube on the under side of the box, as applied to this machine; the form of the box and the manner in which it is connected with the cylinders, and tube on the bottom of the box."

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44. For a *Reaction water wheel;* Abraham Straub, Milton, Northumberland county, Pennsylvania, March 12.

This reaction wheel is to be in the form of a drum, or cylinder, like Wing's, and many others; but it is to have only two buckets, or floats, and two points of discharge; each bucket is to exceed a half circle, to allow their lapping over at the discharge orifices. The great point upon which the patentee depends, is the peculiar kind of curves which he gives to his two buckets, "the nature of which is such an involute as that its distance from its centre shall increase regularly and continually, thereby affording an uninterrupted discharge to the water, without any resistance being offered from the imperfections of shape found in those methods heretofore used." These involutes, or buckets, differ but little from segments of circles, and notwithstanding the applied mathematics of the patentee, we are fully convinced that were he to make his own wheel, and another in all respects similar, but with the buckets segments of circles, he would never, from their effects, discover the difference between the two. Every practical man knows to what a short distance theory will conduct him as a sure guide in hydraulic undertakings. We do not think it necessary to give the patentee's mode of describing his curve.

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45. For a *Bed-bug destroyer;* Brittain Garrard, Maysville, Blount county, Tennessee.

Although three or four patents have been obtained for scalding bugs to death by steam, and although the kind of thing used for the purpose was well known prior to the obtaining of the first patent, it seems that there are yet some which have escaped destruction. The present patentee makes some change in the arrangement of his steam kettle, or boiler, rendering it

somewhat more complex, but we do not think more convenient, than heretofore. We shall not describe, as the patentee has not claimed, the alterations, or improvements, made in "the family safety scalding pot and steam engine."

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46. For a *Mantle and Fender for fire places;* Elijah Skinner, Sandwich, Stafford county, New Hampshire. First patented April 19th, 1822. Patent surrendered and reissued March 12.

Neither the original, nor the renewed, specification presents any claim, and the principal, we believe the only, difference between them, is that the description in the latter is less full and clear than that of the former. The mantle is to be of sheet, or of cast-iron, and projects out like a shelf, having a facing descending at right angles from it. The fender is to be a thing of sheet-iron, bent thus |‾; one edge of it going against the back of the chimney, and the other resting on the hearth, so as to cover the fuel and form a close stove. These affairs appear to be independent of each other, and ought, in this case, to have been the subject of two patents; we do not think, however, that the point is worth disputing.

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47. For a *Cooking Stove;* John Liddle, Schoharie, county of Schoharie, New York, March 12.

A furnace is to be surrounded by a rectangular chamber, furnished with doors, and intended either for baking, or boiling, having openings in its lower side, over the fire, to receive boilers; when used for baking, these openings are to be closed by a cast-iron slide. Each end of this chamber forms a flat flue, communicating with flues surrounding an oven which surmounts the chamber first named. As we are left to discover the novelties in this contrivance, by the entire omission of a claim, we shall transfer the task to the reader.

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48. For a *Cheap Lock;* Abel Conant, Lowell, Middlesex county, Massachusetts, March 12.

It so happens that this lock is not a lock, but merely a spring bolt, not a word being said about a key, or any contrivance for securing the bolt. The parts which are individually described, are, when put into their proper places, to form a mortise bolt, or fastening. The back part of the bolt, which occupies the interior of the box, is a quadrangular frame, which is forced back by means of a dog, or cam, in the usual way. A zigzag spring placed within the bolt, and bearing against the case of the tumbler and the front end of the hollow bolt, forces it forward. There are four individual claims, some of which, we apprehend, will not be sustainable. The first is to the cheap construction, which, as a result, may be very good, but as a claim is somewhat equivocal; the second, is to the transferring of a large portion of the champfer of the bolt to the catch, thus allowing the bolt to be reduced in thickness—which must certainly abridge the distance to which the bolt will throw out, and produce some inconvenience. The third is to the application of the zigzag spring within the hollow of the bolt, and the fourth, "to the use of cast, or wrought iron, knobs, or handles, in place of glass, wood, brass, or other metal." In this last particular, there is neither invention, nor discovery, but a mere change of materials; the validity of which, as a foundation of a claim, we must doubt.

49. For a *Cast-iron Fire place;* William Burgess, Middleborough, Plymouth county, Massachusetts, March 12.

An open, cast-iron, fire place is to have two, or more, ovens, at the back of it. The fire place must project out into the room, as the openings into the oven are at each end. There are also to be openings between, and at the back of the ovens, forming flues around which the heated air may pass. The claim is to "the application of the oven and cooking apparatus, to the common open fire place, or frame, as above described." The contrivance here claimed, resembles many others, and is not distinguished from them by any thing presented in the specification.

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50. For *Machinery for making Cap Wire;* Melville Kelsey, city of New York, March 12.

The claim made in this machine is to "the principle of using two, or more, bobbins at the same time, upon the same spindles, thereby turning off the work much faster." The wire passes through a hollow mandrel, or spindle, upon one end of which are the bobbins and flyers. The description of the machine is not by any means clear, nor is the drawing a very descriptive one, but still, we believe, that by a competent workman, the machine might be made with their aid.

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51. For an improvement in *Piano Fortes;* Henry Hartge, city of Baltimore, March 12.

The improvement here claimed, consists in making the tuning block of a piano forte, in part of wood, and in part of iron, in a way which we believe to be new. The wooden tuning block may be covered with an iron plate three-eighths of an inch in thickness, and the holes for the tuning pins be bored through the iron, and into the wood. The iron plate prevents the pins from being drawn out of perpendicular by the tension of the strings, whilst the pin has the advantage of being kept from turning by the elasticity of the wood. The claim is to "the metallic plate fastened to the tuning block, with holes for the tuning pins to pass through, furnishing additional security and permanency to such pins, and giving increased firmness to the tuning block, thereby aiding to keep the instrument in tune." We have no doubt of the goodness of this contrivance, or of its superiority to the devices which have preceded it in instruments where frames in part, or wholly, of iron, have been used to sustain the tension of the strings.

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52. For an improvement in *Capstans for Ships or other vessels;* Andrew Morse, Jr., Boston, Suffolk county, Massachusetts, March 12.

The main body of this capstan revolves upon a hollow shaft firmly fixed in the deck of the vessel, and is turned by handspikes, in the usual way. It has a cap fixed upon a stout iron shaft, which iron shaft passes through the hollow shaft first mentioned, and extends to the lower side of the deck, and there carries a spur wheel, which mashes into another spur wheel upon a second shaft which passes up through the deck. The upper end of this second shaft has also a small spur wheel upon it, which mashes into a large wheel surrounding, and firmly fixed to, the lower end of the capstan. The small spur wheel upon the second shaft may be thrown out of gear at pleasure. The usual palls, to prevent back motion are, of course, employed. When the small spur wheel is thrown out of gear, and the windlasses are made to turn the main body of the capstan, it operates

without any aid from the gearing; but when the small wheel is in gear, and the handspikes are applied to the cap, the power is increased in a degree dependent upon the proportionate sizes of the train of wheels.

"The invention here claimed, and desired to be secured by letters patent, is the improvement of the ships' or vessels' capstan, so that increased power may be obtained at pleasure, as above described; with the arrangement, application, and adaptation of the several parts as herein set forth."

At page 394, Vol. xvi., a capstan is described, which operates upon the same principle with the foregoing, although not under precisely the same arrangement; this was patented in May, 1835. One very similar was patented in England, in February, 1827, see Newton's Journal, 2nd series, vol. ii, p. 66. Another still more like in arrangement, and precisely similar in effect, was patented by Capt. Phillips, in England, in 1819, see Newton's Journal, vol. ii, p. 1. Other examples might be offered, but these, it is supposed, will suffice. We are aware that the patentee may point out variations from these, which he may deem important; but we cannot perceive any substantial difference between his plan and that of Capt. Phillips, or any change which might not have been made by an ordinary workman who had no claim to inventive talent.

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53. For a *Cotton Baling Press;* James C. Mitchell, Madison county, Mississippi, March 12.

In this press there are two followers, which, in pressing, are made to approach each other, by two shafts, each having a right handed screw cut on one end, and a left handed screw upon the other. The screws stand vertically, their upper ends revolving in collars in the cap of the press, and having spur wheels upon them above the cap. Their lower ends work in steps in the side of the press. The two followers have nuts let into them adapted to the screws. As this press is intended for baling cotton, there is a portion of each screw shaft, in the middle, which is left square, for nearly the thickness of a bale. A large spur wheel, on a vertical axis, turned by horse, or other, power, mashes into the wheels on the upper ends of the screw shafts, the right and left handed screws then cause the followers to approach, or recede, according to the direction in which they are turned.

The dimensions of the respective parts, and the appendages necessary for the packing of cotton, are sufficiently described in the specification. The construction of the press, with the exception of the wheels for working it, is claimed as entirely new.

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54. For a *Compound Lever Tooth Extractor;* Moses P. Hanson, Bangor, Penobscot county, Maine, March 12.

This instrument is the same in principle with others which have been made for the same purpose. The tooth is to be seized by forceps, and to be drawn by causing a part of the instrument to rest upon the adjoining teeth, or gums, to operate as a fulcrum in drawing the tooth. Many teeth could not be drawn by means of such an instrument, and it is always objectionable, as the teeth upon which the fulcrum rests must be forced in with a power equal to that required for extracting the one to be drawn. We have now a similar instrument in our possession, and have seen many others. A good forceps, or key, correct judgment, a firm grip, and a strong wrist, require no patent, nor any improvement.

55. For *Drying paper by the application of Dry Heat;* Henry P. Howe, Shirley, Middlesex county, Massachusetts, March 12.

In the manufactories where cylinder paper is made, the sheet is dried by means of large, iron cylinders, into which steam is admitted through a hollow gudgeon; but the present patentee places a furnace within his cylinder, instead of using steam. We are by no means convinced, however, that the plan which he proposes is a real improvement, although we cannot offer any decided opinion on the subject, as the construction and management of the furnace, and some other points, are obscurely presented, and there is not any thing claimed.

56. For *Forge Backs for Blacksmiths;* Charles Richardson, Greenfield, Hillsborough county, New Hampshire, March 12.

There have been numerous patents for hollow, cast-iron, forge backs, many of them marked by very slight differences. We do not, in the one before us, see any thing worthy of particular notice. The patentee claims a "spiral plate of cast-iron, and the peculiar form and size of the swelled front, or convex part in the front part of the box." The spiral plate is a partition to cause the admitted air to circulate, and to become heated prior to its exit.

57. For an improved *Steam Boiler for generating Steam, to be used in the drying of paper;* John Ames, Springfield, Hampden county, Massachusetts, March 12. See specification.

58. For a *Machine for making Butts and Hinges;* Welcome Whitaker, Troy, New York, March 12.

We can afford but little more than the claims preferred by the patentee of this machine, which is intended to bend sheet metal round the joint wire, so as to form the knuckles of hinges. The description, which occupies several sheets of paper, might have been abridged by making duplicate drawings, and referring to them by letters, or figures, and whilst it would have lost in length, it would have gained in distinctness. The drawing is a well executed perspective, but showing only one view of the machine.

The claims are to "the manner and principle of placing, holding, and supporting the wire round which the tongues of butts, or hinges, are to be bent and formed into eyes, together with the manner of securing the hinge for that operation. The manner and principle of bending the tongue round the wire, either by allowing the ends of the dogs to slide upon their surface, or by causing them to roll and not slide. And also the above described machine, and every part of it, together with the manner, and principle of its construction and operation, as therein combined, and as constituting a whole, and as specially applied to the purposes of bending the tongues of the butts and hinges, and forming them into eyes."

59. For a *Detacher, for detaching horses from carriages, &c.;* Philip T. Share, city of Baltimore, March 18.

Numerous patents have been obtained, both here and in Europe, for detaching horses from carriages, in case of their running away; and many of them are sufficiently simple and efficient, but they have not been kept in use, nor are they likely to be so. We have no fault to find with the contrivance before us, nor any praise to bestow upon it, as it does no

appear to be either better or worse than several of its predecessors. Sailors are proverbially averse to cork jackets, and other life-preservers, and other classes act, more or less, from the same kind of impulse; there is a feeling adverse to the constantly guarding against evils which are contingent, and are believed to be remote. Where by one act, like insuring against fire, the precaution is in its nature durable, prudent men will resort to it, but, otherwise, rarely. The contrivance which has become our text, will soon be forgotten, and be succeeded by analogous inventions, destined to share the same fate.

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60. For *the use of Gum Elastic in Corsets, Braces, &c.;* Ransom Warner, city of New York, March 18.

"I claim as my own invention, the application and introduction of gum elastic into the braces for the shoulders; for corsets; for men's and women's apparel; for suspenders; for the curved and distorted spine; for retaining the fracture of the collar bone in its place; and the applying of the gum elastic to the human system to supply artificial muscular power, so as to meet the antagonist muscle, or to supply strength to the weakened fellow muscles, in proportion to the necessity of the case, or as the contractile power may be required."

It is too late to claim the introduction of India rubber into braces, &c. &c., in the broad way in which it is claimed above, as it has been repeatedly used in webbing, and in other forms, for some of the purposes named. As regards several of these, we apprehend that its successful employment will baffle the skill of the patentee, although we should be glad to think otherwise.

(TO BE CONTINUED IN OUR NEXT.)

NOTE. We have not noticed one half of the patents for the month of March, the whole number being 133; the remainder will be given in our next; this, we are aware, will throw us another month in arrear with our notices, which we intend shall usually follow six months after that in which the patents are dated. The diminished number issued immediately after the passing of the new law, will enable us to overtake the business, without giving an undue length to the article containing our animadversions, as would have been the case had we included the whole for the month of March, in the present number.

SPECIFICATIONS OF AMERICAN PATENTS.

Specification of a patent for an improved Boiler for generating steam. Granted to JOHN AMES, *Springfield, Hampden county, Massachusetts, March 12th,* 1836.

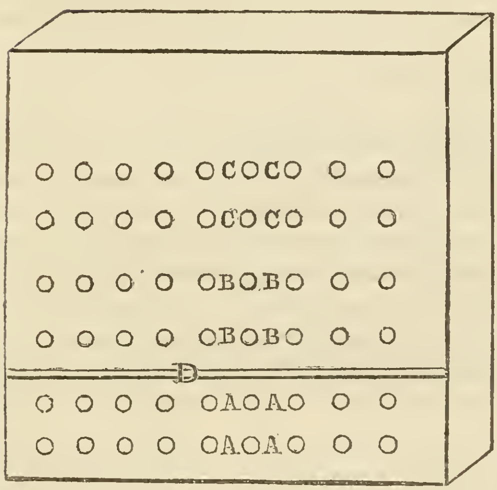
To all whom it may concern, be it known, that I, John Ames, of Springfield, in the county of Hampden, and state of Massachusetts, have invented an improved boiler for the generating of steam, to be used in the drying of paper, and for other purposes, and do hereby declare that the following is a full and exact description thereof.

As this boiler is not intended to be used for steam of great elasticity, but is designed mainly, to produce it in large quantity, I intend, usually, to make it of cast-iron, although wrought-iron, or other metal, may be used if preferred. It may be made of various sizes, and in different shapes,

but for the sake of description, I will give the dimensions of one which I have tried, and found to answer well. It consists of a box four feet square, and two feet deep, the two sides being open, but furnished with flanches for the purpose of bolting on the two plates which are to form the two sides of the stove. Tubes, forming flues, in the manner of the boilers now in general use for locomotive engines, are to pass through these side plates. In the one alluded to, the plates are cast with six rows of holes, nine in each, and about two inches in diameter. The upper row of tubes must be sufficiently below the water line to insure their being constantly covered; and above the water there must, of course, be sufficient space to form a steam chamber, or reservoir.

When this boiler is set, the draught from the fire place below it passes through two rows of the tubes, is returned through the next two, and finally through the upper rows. The manner of forming the flue by divisions, extending from the brick work to the sides of the boiler, between the respective pairs of rows will be readily understood by reference to the drawing which accompanies this specification.

Fig. 1.



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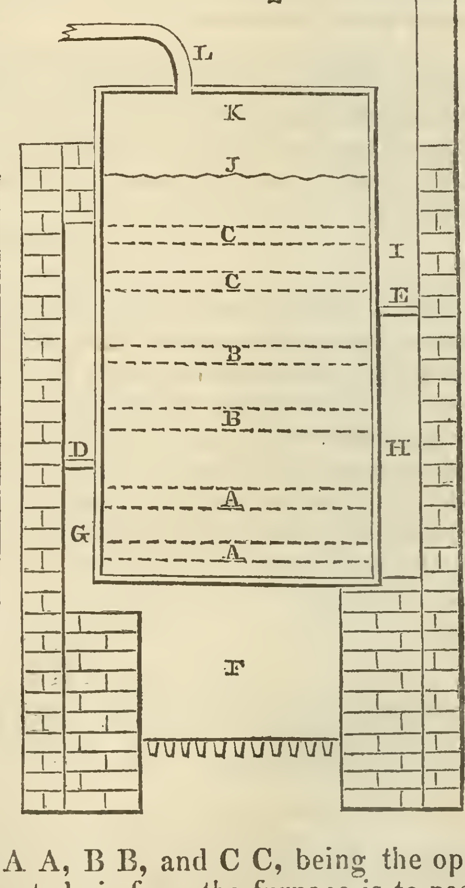


Fig. 1. is a side view of the boiler A A, B B, and C C, being the open ends of the tubes through which the heated air from the furnace is to pass, as will be shown more distinctly in fig. 2. D, is one of the ledges or partitions which project out from the boiler, occupying the space between it and the masonry in which the boiler is set, and causing the draught to enter the tubes A A, in order to its returning through those marked B B.

Fig. 2, is a vertical section of the boiler and furnace, cutting the boiler from front to back. A A, B B, and C C, are the double ranges of tubes,

as in fig. 1, represented by dotted lines. D and E, are partitions which direct the draught through the tubes in the following manner. Let F represent the furnace, and C a part of the flue into which the tubes A A, open, the draught being arrested by the partition D, will pass through A A, into the flue H, and being arrested by the partition E, will return through the tubes B B, then pass those marked C C, into the flue I, leading into a smoke pipe, or chimney; J, may represent the water line, K, the steam chamber, and L, the steam pipe.

Although I have mentioned a certain number of tubes, and have said that in the boiler which I have tried, the heated air is made to pass through the water three several times, it is manifest that the same operation may be repeated as frequently as it shall be found advantageous so to do. The number of tubes also, may be varied, and they may be placed in single rows, or otherwise, without altering the principle of action.

I have not mentioned the safety valves, cocks, or other general appendages to steam boilers, as in these I do not profess to have made any improvement; nor have I described any particular manner of securing the tubes, this being well known to engineers.

A boiler thus made, is recommended by its simplicity and economy, where it is desirable to generate a large quantity of steam under a moderate pressure, as for the purposes of heating and drying in various manufacturing processes. What I claim as my invention in it is the general combination and arrangement of the parts by which the draught from the fire is made to pass repeatedly through the water, as herein set forth, whether made in the exact form represented, or in any other which is substantially the same in its construction and operation.

John Ames.

Progress of Physical Science.

On a new Force acting in the Formation of Organic Compounds. By M. Berzelius. *(Jahrbuch de Schumacher, for* 1836).

When new compounds are produced in inorganic nature as the result of the reaction of different bodies, it is in consequence of a mutual tendency of those bodies to satisfy the laws of their affinity in a more complete manner. First, the substances possessing dominant affinities enter into combination, and then those of feeble affinities which were excluded from the first combination. Before the year 1800, the existence, in these phenomena, of any other determining cause than the degree of affinity, heat, and, in some cases, light, was scarcely suspected. The influence of electricity was then discovered, and we soon saw ourselves in danger of confounding the electrical with the chemical relations of bodies, and of considering their affinities only as the manifestation of a strong electrical contrast, increased by light and heat. This system offered no other means of explaining the origin of a new compound, than by the supposition, that, by the approximation of bodies which are present, their electrical states become neutralized in a more perfect manner.

Setting off from these ideas, deduced from the effects which occur in inorganic nature, and studying the chemical re-actions presented by organized bodies, we perceived that in the organs of the latter, substances the

most various were elaborated, while the brute matter, whence they proceeded, consisted, in general, of but one liquid, circulating in vessels with more or less velocity. The vessels of the animal body, for example, pump blood from their origin without interruption, and nevertheless, secrete milk, bile, urine, &c. at their extremities, without admitting any other liquid capable of producing, by double affinity, any decomposition whatever. A fact here evidently occurs, which the study of inorganic nature was then unable to explain.

At this period M. Kirchhoff observed that starch dissolved in diluted acid, became converted, at a certain temperature, first into gum, and afterwards into grape-sugar. In conformity with the principles then received with regard to effects of this kind, an endeavour was made to ascertain what the acid had removed from the starch to reduce it into sugar; but no gas had been disengaged, the acid re-appearing by means of the alkalies in its primitive quantity, had not been combined, and the liquid contained only sugar in an equal, or even a larger, quantity than the starch which had been employed. The cause of this alteration was as problematical as that of the secretions in the organic body. M. Thénard then discovered the peroxide of hydrogen, a liquid, the elements of which are retained in combination by a very weak affinity. The acids do not produce any alteration in it; the alkalies, on the contrary, produce in it a tendency to decomposition, a species of fermentation, which reproduces water, in consequence of a disengagement of oxygen. But the most interesting circumstance, is, that the same effect takes place from the action of different solid bodies insoluble in water, organic as well as inorganic; for example, from the presence of peroxide of manganese, of silver, platinum, and also the fibrin of animal blood. The body which determines the decomposition does not undergo any alteration, it does not act as an element of a new compound, but by virtue of a peculiar force inherent in its mass, the existence of which, though unknown in its essence, is demonstrated by its effects. Shortly before M. Thénard, Sir H. Davy remarked another phænomenon, the analogy of which with the one just described, was not immediately perceived. He had proved that platinum, heated to a certain degree, and brought into contact with a mixture of the vapour of alcohol, or ether, and atmospheric air, possessed the power of determining and sustaining the combination of these bodies, while gold and silver were devoid of this property. Soon after, Mr. E. Davy discovered a preparation of platinum in a state of very great mechanical division, having, at ordinary temperatures, and after having been moistened with alcohol, the property of becoming incandescent by the combustion of alcohol, altogether in converting it by oxidation, into acetic acid. Then followed the discovery of Döbereiner, the most important of all. He proved that it is the property of spongy platinum to inflame, spontaneously, a current of hydrogen gas projected in the air; a phenomenon which the researches of M. M. Thénard and Dulong proved is produced by several other bodies, simple as well as compound: with this restriction, however, that while platinum, iridium, and some other platinal metals, act at temperatures below zero, other bodies, such as gold, and more especially silver, require a much higher temperature, and glass a heat even of above 300°. Thus what was at first considered as an exceptive mode of action, appeared to be a general property, though variously graduated, of all bodies, and from the application of which, advantage might be derived. We know, for example, that in the act of fermentation, in the conversion of sugar into alcohol and carbonic acid, the

action exercised by the insoluble substance named leaven, and which may be replaced, though with less success, by animal fibrin, albumen, and caseous substances, &c., cannot be explained by any chemical reaction of the affinities of the sugar and the leaven, and that no effect in inorganic nature approaches it so nearly as the action of platinum, silver, or fibrin in the decomposition of the peroxide of hydrogen into oxygen and water. It was natural here to suppose an analogous mode of action. The conversion of starch into sugar, by means of sulphuric acid, had not yet been co-ordinated with the preceding facts; the discovery, however, of diastase (announced in the Annual Report for 1833), a substance acting upon starch in an analogous manner, only with more energy, directed attention to this analogy, which was definitively proved by the ingenious researches of M. Mitscherlich upon the formation of ether. Among the numerous theories upon the formation of ethers, one, we know, makes the property of sulphuric acid to convert alcohol into ether, to depend upon its power of absorbing water, granting, that the alcohol, considered as a compound of one atom of etherine ($C^4 H^3$), and of two atoms of water, is reduced into ether, by ceding the half of its water to the acid. This theory, equally simple and ingenious, was in perfect agreement with our knowledge of the reaction of the affinities of bodies; it did not, however, explain why other bodies, not acids, having equal avidity for water, could not be employed in the same manner; why soda, potash, chloride of potassium, anhydrous lime, &c., if the transformation really depended only upon an affinity for water, did not equally produce ether. The researches of M. Mitscherlich proved that sulphuric acid, sufficiently diluted, and taken at such a temperature that the refrigeration produced by the addition of the alcohol, compensated for the heating which arose from the mixture, decomposed the alcohol into ether and water, which, because the temperature exceeded the temperature of ebullition of water, were both separated by distillation from the mass, and, as soon as the condensation was complete, presented a mixture of the same weight as that of the alcohol employed. The manner of performing this experiment, as well as the fact of the distillation of water conjointly with alcohol, was, it is true, known before M. Mitscherlich, but to him belongs the merit of having predicted its consequences. In fact, he proved that at this temperature, sulphuric acid must act upon alcohol by virtue of the same force which determines the action of the alkalies upon oxygenated water, since the water being entirely separated from the mixture, did not obey an affinity for the acid; whence he concluded, that the action of sulphuric acid and diastase upon starch, from which resulted the sugar, must be of the same nature.

It is then proved that many substances, simple or compound, solid or in solution, have the property of exercising an influence upon compound bodies essentially distinct from chemical affinity, an influence which consists in the production of a displacement, and a different arrangement, of their elements, without participating in it directly and necessarily, except in a few special cases. Certainly a force such as this, capable of producing chemical reactions in inorganic nature, as well as in organized bodies, though at present too little understood to be well explained, must exercise a more important function in nature than has hitherto been supposed. In defining it as a new force, I am far from wishing to deny that a certain connexion exists between it and the electro-chemical relations of matter. I am, on the contrary, strongly disposed to recognize in it a decided manifestation of these relations; nevertheless, till we have penetrated into the

real nature of this force, it will be more simple in our future researches to consider it as independent, and to give it, for facility of recognition, a name peculiar to itself. According to an etymology well known in chemistry, I shall consequently name it the CATALYTIC FORCE of bodies, and the decomposition which it determines *catalysis*, in the same manner as the separation of the elements of a compound, by means of the usual chemical affinities, is called *analysis*. This force may be defined to be *a power of bodies to bring into activity, by their simple presence, and without participating in it chemically, certain affinities, which at that temperature would remain inactive, so as to determine, in consequence of a new distribution of the elements of the compound, a new state of perfect chemical neutralization*. As this force acts in general in a manner analogous to heat, it may be inquired whether being variously graduated, sometimes by employing differently the same catalytic body, sometimes by the introduction of various catalytic bodies in the same liquid, it will cause, as is often observed in the action of heat at different temperatures, different catalytic products,—whether the catalytic force of a body can be exerted over a large number of compounds, or whether, as our experiments appear to indicate, only over certain bodies, to the exception of certain other bodies? But in the present state of our knowledge it is impossible to decide these questions, and many others that might be proposed upon the subject: their solution must depend on the results of future investigations. It is enough, for the present, to have shown, by a sufficient number of examples, the existence of this force, which, defined as it has been, diffuses a new light over the chemical reactions of organized bodies. We shall cite but one example. There is an accumulation of diastase around the eye of the potatoe, which is not found in the tubercle or in the developed germ; we perceive in this point a centre of catalytic action, at which the insoluble starch of the tubercle is converted into gum and sugar, and this part of the potatoe will become the secreting organ for the soluble substances, which are to form the juices of the growing germ. It is not probable that the action mentioned is the only one of its kind in vegetable life; on the contrary, it may be presumed, that in vegetables, as well as in the animal body, a thousand catalytic effects take place between the tissues and the liquids, whence results the great number of different chemical compounds, the production of which, from the same brute matter, which we call blood, or vegetable juices, cannot be explained by any other known cause.—*Bibliothéque Universelle, Nouv. Ser. Tome ii., p. 376.* A. T.

Rep. Pat. Invent. Aug.

Sixth Meeting of the British Association for the Advancement of Science.

The Annual Sessions of this Association were commenced by a meeting of the General Committee, at Bristol, on Saturday, August 20, and were continued throughout the following week. The arrangement was, that the Sections should meet at eleven o'clock every day during the week, and that the General meetings of the Association should be held at 8 o'clock on the evenings of Monday, Wednesday and Friday. The concluding meeting to take place on Saturday, at an hour fixed by the General Committee. Several public dinners were given, and an ordinary was provided daily, at the Horticultural rooms, for strangers, at 5*s.* per head. The number of members in attendance exceeded that of any previous meeting,

and amounted to about 1350. The business of the Association is conducted by several Committees and Sections, as follows:

Section A. *Mathematical and Physical Science.*
President, Rev. W. Whewell.
B. *Chemistry and Meteorology.*
President, Rev. Prof. Cumming.
C. *Geology and Geography.*
President, Rev. Dr. Buckland.
D. *Zoology and Botany.*
President, Prof. Henslow.
E. *Anatomy and Medicine.*
President, Dr. Roget.
F. *Statistics.*
President, Sir Charles Lemon, *Bart.*
G. *Mechanical Science.*
President, Davies Gilbert, Esq.

The President of the Association was the Marquis of Landsdowne, who was prevented from attending by the illness of his eldest son, the Earl of Kerry, who died during the week of the Sessions. The chair was taken by the Marquis of Northampton, one of the Vice Presidents.

The business of the week appears not to have been excelled, in point of interest, by that of any prior meeting of the Association. Most of the British Savans whose names are well known throughout the scientific world, were present, except that among those whose names now occur to us, and which we do not find in the list of attendants, are Faraday, Airy, and some others. Among the learned strangers, were Baron Dupin of the French Institute, and Dr. Hare of Philadelphia. The latter was elected one of the Committee of Section B. His several communications were evidently received with most respectful attention, and at the public dinner, where nearly 500 persons were present, we find him on the right of the chair next to Prof. Whewell.

"The interest excited throughout the week, (observes the correspondent of the London Athenæum,) cannot be conceived by those who were not present. The mass of interesting matter brought forward was quite unexpected. Prof. Sedgwick said that the present meeting was worth all previous ones put together—that now the British Association was really advancing Science, all the branches of which were becoming more and more connected with each other. The new views of Physical Science brought forward at the Geological Section, were the most important advances yet made in Geology. This would gradually be numbered among those branches of knowledge under the dominion of mathematical laws, and be eventually placed in the same ranks with her kindred sister Astronomy."

The sum devoted to scientific enquiries during the ensuing year exceeds £2700! The next meeting of the Association is to be held at Liverpool, rather later in the year than the present; the day to be fixed by the General Committee.

The office bearers chosen for the meeting in 1837, are the Earl of Burlington, President; Dr. Dalton, Sir Philip Egerton, Rev. E. G. Stanley, Vice Presidents; Dr. Charles Henry, Mr. Parker, Secretaries.

Our extracts from the published accounts of the various matters brought forward in the different Sections must, necessarily, be limited to a few of those that appear to possess the greatest novelty and interest.

Change in the Chemical character of Minerals induced by Galvanism. By R. W. Fox. This communication was from a gentleman long known in connexion with Science, and largely connected with the mining districts of Cornwall. Nothing which occurred at the meeting appears to have produced a higher interest than this communication, and the one which immediately followed.

Mr. Fox exhibited the extraordinary experiment of the change of yellow into the grey sulphuret of copper. In a trough a mass of clay was placed so as to divide it into two portions, in one of which was sulphate of copper in solution, in the other dilute sulphuric acid. On the electric communication being made by placing the yellow sulphuret in the solution, and a piece of zinc in the acid, the change of the sulphuret took place, and crystals of native copper were also formed upon it.

Mr. Fox then made some remarks upon the electro-magnetism of veins. It was plain that when a rock contained mineral matter, the rock and its contents must be in different electrical states, so that electricity must exist in very great activity in the interior of the globe. He referred to his experiments recorded in the Transactions of the Geological Society. He alluded to the north-east and south-west directions of the Cornish veins, and he had ascertained that there are Voltaic currents perpendicular to the magnetic meridian. Tin is found to exist in veins, or in different parts of the same vein; and, in experimenting, he found that metallic tin went to the positive, and oxide of tin to the negative pole of the apparatus. He was also struck with a kind of polarization in the disposition of the matter of veins; thus, iron and copper presented distinct relations to each other; the grey sulphuret of copper was uniformly found above the yellow; the quartz of N. and S. veins were striated, that of E. and W. veins not so. The phenomena of the intersection of veins were also spoken of; the old supposition, that one vein must be older than the other, need not be resorted to in all cases, as it could be proved that crossing veins were often of simultaneous origin.—Dr. Buckland pointed out Mr. Fox's experiment as an illustration of the simplicity of the means which nature had adopted in her most subtle operations, and expressed his hope that this new application of electro-chemistry to geology, would furnish a series of results of paramount importance. Indeed, one of the great benefits conferred by the British Association on science, was the bringing forward individuals who had devoted themselves in private, to scientific investigation and experiment, which often, as in the case of Mr. Fox, opened the portals that led to new views of nature and her operations. He had now to introduce to the notice of the Section another gentleman, who had for many years, in private seclusion, occupied himself in experiments of a novel and extraordinary character, and also making use of apparatus of the most simple description. He then presented to the notice of the meeting, Mr. Cross, who would give a verbal account of his most singular proceedings.

Artificial Crystals and Minerals. A. Cross, Esq. of Bloomfield, Somerset, then came forward and stated that he came to Bristol to be a listener only, and with no idea that he should be called upon to address a Section. He was no geologist, and but in a moderate degree a mineralogist. But, being early impressed with the notion that it would be desirable to produce, if possible, a long continued, undiminished electrical action, he had set himself to work, and after many trials he had constructed an apparatus, which had for no less than an *entire year* retained its electric energy, and

this by the agency of pure water only. He had also conceived, that it being by long continued processes that nature produced most of the effects which we observe, it might be possible to form substances similar to what she affords, by adopting a mode like hers. His attention had been directed to a cavern in the Quantock Hills, in which he had observed calcareous spar incrusted on limestone, and arragonite on clay slate: these minerals had evidently been formed by the water which percolated the rocks. Some of this water he brought to his house, and presented it to the action of his Voltaic apparatus; for nine days he anxiously watched for a result, but no visible one offering, he had almost given up the experiment, when on the tenth day, to his great delight, he succeeded in procuring minerals the same as in the cavern. He was thus encouraged to prosecute further experiments; and, in the course of his investigations, he found that light was unfavourable to the perfection of crystals, he being enabled, in a much shorter period, and with much weaker electric power, to produce them in the dark. He formed several crystals of metallic minerals, but his most successful experiment was the production of quartz from fluo-silicic acid, and his inspection of what has been perhaps never before observed by mortal eye, the process of crystalline developement from the beginning. He had traced a quartz crystal, first, as a hexagon marked upon the matrix—then lines radiated from its centre—then parallel lines were formed parallel to its sides—it increased in thickness, but, owing to some disturbance of the operation, the process of forming a single perfect crystal was not completed, for a second crystal grew up and intersected it, offering an additional confirmation of the resemblance of Mr. Cross's process to that of nature, where this penetration of crystals into each other is every where to be observed.

It would be extending this report too far to relate all that Mr. Cross communicated to the Section regarding the details of his experiments; but it is impossible to convey an idea of the enthusiasm with which his statement was received by the crowded assembly present. There appeared to be a real *electrical* effect produced upon them; they seemed as if the interior recesses of Nature had been of a sudden laid open to them, and her processes, which had been conceived as past all mortal ken, submitted to their inspection. Mr. Cross was often interrupted during his address with loud peals of applause, which lasted for several minutes after he sat down.—Mr. Conybeare said, that he found himself so excited with the intelligence, that he should not submit his observations on the South Wales Coal Basin; he considered any communication he could bring forward totally eclipsed in interest by the overpowering intelligence brought by Mr. Cross. Upon that gentleman Mr. Sedgwick passed also a highly eloquent eulogium. Professor Phillips stated, that he had now hopes of realizing his fondest dreams of geology. He had long conceived that Nature must have some means of conveying solid matter through solid matter, and that this was now proved by Mr. Cross, whose discoveries were of such importance, that had the British Association been of no other service than in bringing them to light, they alone were worth all the pains it had taken for the advancement of science, and it was its particular business to have experiments like his set on foot, and prosecuted for many years to come.

It was mentioned to the Section on the following day, that although no doubt could be entertained of the independence and originality of Mr. Cross's experiments, yet that he had been anticipated in the artificial production of many of the crystalized bodies which he had formed, by M. Becquerel and some other French Chemists.

Improvements on the Electrical Apparatus for Dancing-Images.

When the plates are not of considerable size the images leap off, and if very large the view is obstructed. To obviate these difficulties, plates of glass are recommended by W. Ettrick, with bands of tin foil pasted in corresponding positions on each side. In fig. 1, a' b' c', and x y z, and a' a, represent

Fig. 2.

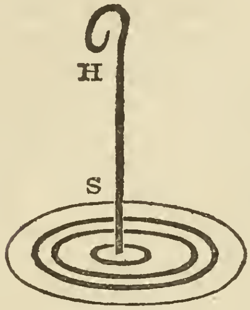
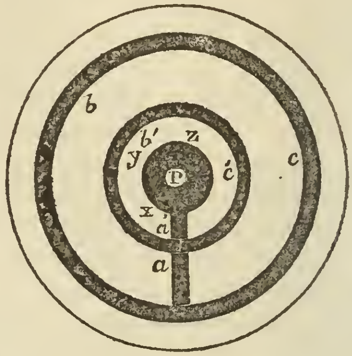


Fig. 1.



pieces of tinfoil pasted on each side of the glass; a hole P being cut in the centre of the glass to pass the tinfoil a a' through, and thereby connect the metallic circular slips. In fig. 2, the rod and crook S H represents the suspending wire, which is screwed into a circular flat piece of brass, upon which the glass plate lies. The slips or rings of tinfoil do not come close to the edge of the glass, which greatly assists in keeping the figures upon the plates, because they will generally touch the tinfoil, as being more charged than the glass. If a similar glass plate be used for the lower plate, it would be a further improvement. Lond. Mech. Mag.

Progress of Practical and Theoretical Mechanics and Chemistry.

Method of separating small quantities of Arsenic from substances with which it may have been mixed. By Mr. James Marsh, *of the Royal Arsenal, Woolwich.**

Notwithstanding the improved methods that have of late been invented of detecting the presence of small quantities of arsenic in the food, in the contents of the stomach, and mixed with various other animal and vegetable matters, a process was still wanting for separating it expeditiously and commodiously, and presenting it in a pure unequivocal form for examination by the appropriate tests. Such a process should be capable of detecting arsenic not only in its usual state of white arsenic or arsenious acid, but likewise that of arsenic acid, and of all the compound salts formed by the union of either of these acids with alkaline substances. It ought, also, to exhibit the arsenic in its reguline or metallic state, free from the ambiguity which is sometimes caused by the use of carbonaceous reducing fluxes. It appeared to me, that these objects might be attained by presenting to the arsenic hydrogen gas in its nascent state: the first action of which would be to deoxygenate the arsenic; and the next, to combine with the arsenic, thus deoxygenated, into the well known gas called arsenuretted hydrogen. Being thus brought to the gaseous state, the arsenic would spontaneously (so to speak) separate itself from the liquor in which it was before dissolved,

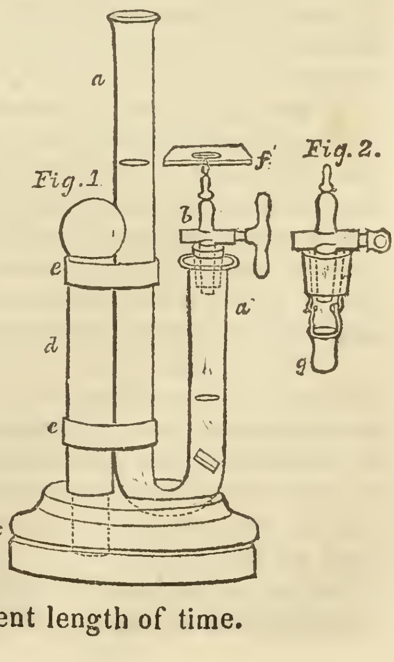
* Received by the Franklin Institute in a pamphlet from London.

and might be collected for examination by means of any common gas apparatus; thus avoiding the trouble, difficulty, and ambiguity of clarification and other processes whereby liquors, suspected of containing arsenic, are prepared for the exhibition of the usual tests, or of evaporation and deflagration which are sometimes had recourse to, in order to separate the arsenic from the organic substances with which it may have been mixed.

I had the satisfaction of finding, on trial, that my anticipations were realized; and that I was thus able, not only to separate very minute quantities of arsenic from gruel, soup, porter, coffee, and other alimentary liquors, but that, by continuing the process a sufficient length of time, I could eliminate the whole of the arsenic in the state of arsenuretted hydrogen, either pure, or at most, only mixed with an excess of hydrogen.

If this gas be set fire to as it issues from the end of a jet of fine bore into the common air, the hydrogen, as the more combustible ingredient, will burn first, and will produce aqueous vapour, while the arsenic will be deposited either in the metallic state, or in that of arsenious acid, according as it is exposed partially or freely to the air. The former condition is brought about by holding a piece of cold window glass opposite to and in contact with the flame, when a thin metallic film will be immediately deposited on its surface; and the latter, by receiving the flame within a glass tube open at both ends, which, in half a minute, will be found to be dimmed by a white pulverulent sublimate of arsenious acid. By directing the flame obliquely within side of the tube, it strikes against the glass and deposites the arsenic partly in the metallic state. In this case, if the tube, while still warm, be held to the nose, that peculiar odour, somewhat resembling garlic, which is one of the characteristic tests of arsenic, will be perceived. Arsenuretted hydrogen itself has precisely the same odour, but considerable caution should be used in smelling to it, as every cubic inch contains about a quarter of a grain of arsenic.

The requisite apparatus is as simple as possible, being a glass tube open at both ends, and about three quarters of an inch in its internal diameter. It is bent into the form of a syphon (*a a*, fig. 1), the shorter leg being about five inches, and the longer about eight inches in length. A stop-cock *b*, ending in a jet of fine bore, passes tightly through a hole made in the axis of a soft and sound cork, which fits air-tight into the opening of the lower bend of the tube, and may be further secured, if requisite, by a little common turpentine lute. To fix the apparatus, when in use, in an upright position, a hole is made in the wooden block *c*, for the reception of the lower part of the pillar *d*, and a groove is cut in the top of the same block to receive the bend of the tube *a a*. Two elastic slips *e e*, cut from the neck of a common bottle of India rubber, keep the tube firm in its place.



The matter to be submitted to examination, and supposed to contain arsenic, if not in the fluid state, such as pastry, pudding, or bread, &c., must be boiled with two or three fluid ounces of clean water, for a sufficient length of time.

The mixture so obtained must then be thrown on a filter to separate the more solid parts: thick soup, or the contents of the stomach, may be diluted with water and also filtered; but water-gruel, wine, spirits, or any kind of malt liquor and such like, or tea, coffee, cocoa, &c., can be operated on without any previous process.

When the apparatus is to be used, a bit of glass rod, about an inch long, is to be dropped into the shorter leg, and this is to be followed by a piece of clean sheet zinc, about an inch and a half long and half an inch wide, bent double, so that it will run down the tube till it is stopped by the piece of glass rod first put in. The stop-cock and jet are now to be inserted, and the handle is to be turned so as to leave the cock open. The fluid to be examined, having been previously mixed with from a drachm and a half to three drachms of dilute sulphuric acid (1 acid and 7 water,) is to be poured into the long leg, till it stands in the short one about a quarter of an inch below the bottom of the cork. Bubbles of gas will soon be seen to rise from the zinc, which are pure hydrogen if no arsenic be present; but, if the liquor holds arsenic in any form of solution, the gas will be arsenuretted hydrogen. The first portions are to be allowed to escape, in order that they may carry with them the small quantity of common air left in the apparatus; after which the cock is to be closed, and the gas will be found to accumulate in the shorter leg, driving the fluid up the longer one, till the liquor has descended in the short leg below the piece of zinc, when all further production of gas will cease. There is thus obtained a portion of gas subject to the pressure of a column of fluid of from seven to eight inches high: when, therefore, the stop-cock is opened, the gas will be propelled with some force through the jet, and, on igniting it as it issues (which must be done quickly by an assistant,) and then holding horizontally a piece of crown or window class (*f*, fig. 1) over it, in such a manner as to retard slightly the combustion, the arsenic (if any be present) will be found deposited in the metallic state on the glass; the oxygen of the atmosphere being employed in oxydizing the hydrogen only during the process. If no arsenic be present, then the jet of the flame as it issues has a very different appearance; and, although the glass becomes dulled in the first instance by the deposition of the newly formed water, yet such is the heat produced, that in a few seconds it becomes perfectly clear, and frequently flies to pieces.

If the object be to obtain the arsenic in the form of arsenious acid, or white arsenic, then a glass tube, from a quarter to half an inch in diameter (or according to the size of the jet of flame,) and eight or ten inches in length, is to be held vertically over the burning jet of gas, in such a manner that the gas may undergo perfect combustion, and that the arsenic combined with it may become sufficiently oxydized; the tube will thus, with proper care, become lined with arsenious acid in proportion to the quantity originally contained in the mixture.

When the glass tube is held at an angle of about forty-five degrees over the jet of flame, three very good indications of the presence of arsenic may be obtained at one operation; viz. metallic arsenic will be found deposited in the tube at the part nearest where the flame impinges,—white arsenic or arsenious acid at a short distance from it,—and the garlic smell can be readily detected at either end of the tube in which the experiment has been made.

As the gas produced during the operation is consumed, the acid mixture falls into the short limb of the tube, and is thus again brought into contact with the

zinc, in consequence of which a fresh supply is soon obtained. This gas, if submitted to either of the processes before described, will give fresh indications of the presence of the arsenic which the mixture may have originally contained; and it may be easily perceived that the process will be repeated as often as may be required, at the will of the operator, till no further proofs can be obtained.

When certain mixed or compound liquors are operated on in this apparatus, a great quantity of froth is thrown up into the tube, which may cause a little embarrassment by choking the jet. I have found this effect to take place most with the contents of the stomach, with wine, porter, tea, coffee, or soup, and, indeed, with all mucilaginous and albuminous mixtures. The means I adopt to prevent this effect from taking place, or, at least, for checking it in a great measure, is to grease or oil the interior of the short limb of the apparatus before introducing the substance to be examined, or to put a few drops of alcohol or sweet oil on its surface previously to introducing the stop-cock and its appendages. I have, however, found, if the tube be ever so full of froth in the first instance, that, in an hour or two, if left to itself, the bubbles burst, and the interior of the tube becomes clear without at all effecting the results.

In cases where only a small quantity of the matter to be examined can be obtained, I have found a great convenience in using the small glass bucket, (*g*, fig. 2). Under such circumstances, the bent glass tube may be filled up to within an inch of the short end with common water, so as to allow room for the glass bucket, which must be attached to the cork, &c. by means of a little platina wire; a bit or two of zinc is to be dropped into the bucket, with a small portion of the matter to be examined, and three or four drops of diluted sulphuric acid; (acid 2, water 14,) and the whole is then to be introduced into the mouth of the short limb of the tube. The production of gas under this arrangement is much slower, and, of course, requires more time to fill the tube, than in the former case, but the mode of operating is precisely the same. Indeed, it is of great advantage, when the quantity of arsenic present is very minute, not to allow the hydrogen to be evolved too quickly, in order to give it time to take up the arsenic.

A slender glass funnel will be found of service when as much as a table-spoonful, or even a tea-spoonful of matter, can be obtained for examination. In this case, the tube is to be partly filled with common water, leaving a sufficient space for the substance to be examined; a piece of zinc is to be suspended from the cork by a thread or wire, so as hang in the axis of the tube; and the fluid to be operated on, having previously been mixed with dilute sulphuric acid, is then to be poured through the funnel carefully, so as to surround the zinc, avoiding, as far as possible, to mix it with the water below, and the stop-cock and its appendages are to be replaced in the mouth of the tube; the production of the gas then goes on as before stated, and the mode of manipulating with it, is exactly the same as described in the foregoing part of this paper.

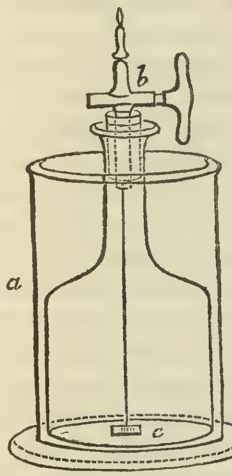
It will be necessary for me, in this place, to explain the methods I employ after each operation, to determine the integrity of the instrument, so as to satisfy myself that no arsenic remains adhering to the inside of the tube, or to the cork and its appendages, before I employ it for another operation.

After washing the apparatus with clean water, a piece of zinc may be dropped in, and the tube filled to within half an inch of the top of the short limb; two drachms of diluted sulphuric acid are then to be poured in, and the stop-cock and cork secured in its place; hydrogen gas will in this case,

as before, be liberated, and fill the tube. If the gas as it issues from the jet be then inflamed, and a piece of window glass held over it as before described, and any arsenic remains, it will be rendered evident by being deposited on the glass; if so, this operation must be repeated till the glass remains perfectly clean, after having been exposed to the action of the gas.

When I have had an opportunity of working with so large a quantity of mixture as from two to four pints, (imperial measure) I have employed the instrument (fig. 3), which is, indeed, but a slight modification of one of the instantaneous light apparatuses, now so well known and used for obtaining fire by the aid of a stream of hydrogen gas thrown on spongy platinum. It will, therefore, be of importance only for me to describe the alteration which I make when I employ it for the purpose of detecting arsenic. In the first place, I must observe, that the outer vessel *a*, which I use, holds full four pints, and that the jet of the stop-cock is vertical, and its orifice is twice or three times larger than in the instrument as generally made for sale, and also that there is a thread or wire attached to the cork of the stop-cock *b*, for suspending a piece of zinc *c*, within the bell glass.

Fig. 3.



With an intrument of this description, I have operated on one grain of arsenic in twenty-eight thousand grains of water (or four imperial pints), and have obtained therefrom, upwards of one hundred distinct metallic arsenical crusts.

Similar results have been obtained with perfect success from three pints of very thick soup, the same quantity of port wine, porter, gruel, tea, coffee, &c. &c.

It must, however, be understood, that the process, was allowed to proceed but slowly, and that it required several days before the mixture used ceased to give indication of the presence of arsenic, and also, a much larger portion of zinc and sulphuric acid was employed from time to time, than when working with the small bent tube apparatus, in consequence of the large quantity of matter operated on under this arrangement.

With the small apparatus, I have obtained distinct metallic crusts, when operating on so small a quantity as one drop of Fowler's solution of arsenic, which only contains one-120th part of a grain.

The presence of arsenic in artificial orpiment and realgar, in Scheele's green, and in the sulphuret of antimony, may be readily shown by this process, when not more than half a grain of any of those compounds is employed.

In conclusion, I beg to remark, that although the instruments I have now finished describing, are the form I prefer to all that I have employed, yet it must be perfectly evident to any one, that many very simple arrangements might be contrived. Indeed, I may say unequivocally, that there is no town or village in which sulphuric acid and zinc can be obtained, but every house would furnish to the ingenious experimentalist ample means for his purpose; for, a two-ounce phial, with a cork and piece of tobacco-pipe, or a bladder, with the same arrangement fixed to its mouth, might, in cases of extreme necessity, be employed with success, as I have repeatedly done for this purpose.

The only ambiguity that can possibly arise in the mode of operating above described, arises from the circumstance, that some samples of the zinc of commerce themselves contain arsenic; and such, when acted on by dilate sulphuric acid gave out arsenuretted hydrogen. It is, therefore, necessary for the operator to be certain of the purity of the zinc which he employs, and this is easily done by putting a bit of it into the apparatus, with only some dilute sulpuric acid; the gas thus obtained is to be set fire to as it issues from the jet; and if no metallic film is deposited on the bit of flat glass, and no white sublimate within the open tube, the zinc may be regarded as in a fit state for use.

Method of determining the value of Black Oxide of Manganese for manufacturing purposes. By Thomas Thomson, *M. D., F. R. S., L. and E. Regius Professor of Chemistry in the University of Glasgow.*

The manganese to be tested must be reduced to a fine powder, or brought into the state in which it is used by the manufacturers of bleaching-powder. To determine its value, proceed in the following manner:

Into a balanced Florence flask put 600 grains of water, and 75 grains of crystals of oxalic acid. Then add 50 grains of the manganese to be tested; and, as quickly as possible, pour into the flask from 150 to 200 grains of concentrated sulphuric acid. This is best done by having a given weight of sulphuric acid, say 210 grains, previously weighed out in a glass measure, counterpoised on one of the scales of a balance. You pour into the flask as much of the sulphuric acid as you can conveniently. Then, putting the measure again into the scale, you determine exactly how much has been put in.

A lively effervescence takes place, and carbonic acid gas is disengaged in abundance. Cover the mouth of the flask with paper, and leave it for twenty-four hours; then weigh it again. The loss of weight which the flask has sustained is exactly equal to the quantity of *binoxide* of manganese in the powder examined. Thus, let the loss of weight be 34 grains; the quantity of binoxide of manganese in the 50 grains of the powder which was tested will be 34 grains; or it will contain 68 per cent. of pure binoxide of manganese, and 32 per cent. of impurity.

To understand what takes place, it is necessary to recollect that oxalic acid is composed of

2 atoms carbon	1.5
3 atoms oxygen	3
	4.5

and that of binoxide of manganese is composed of

1 atom manganese	3.5
2 atoms oxygen	2
	5.5

The oxalic acid acts on the binoxide by abstracting one-half of its oxygen, which converts it into carbonic acid; hence the effervescence. 55 grains of pure binoxide of manganese would give out 10 grains of oxygen, which would convert 45 grains of oxalic acid into 55 grains of carbonic acid; which escaping, indicate, by the loss of weight, the quantity of carbonic acid formed. Now, it happens that the weight of the carbonic acid formed is exactly equal to the quantity of binoxide of manganese which

gives out its oxygen to the oxalic acid. Hence the reason of the accuracy of the test.

In other words, an integral particle of binoxide of manganese, which weighs 5.5, gives out 1 atom of oxygen. This atom of oxygen combines with an integrant particle of oxalic acid, weighing 4.5, and converts it into two integrant particles of carbonic acid, which both together weigh 5.5. As this carbonic acid escapes, the loss of weight must be just equal to the quantity of binoxide of manganese in the powder subjected to experiment.

In practice, I find that a small quantity of the binoxide of manganese sometimes escapes the action of the oxalic acid, being probably screened by the great quantity of impurity with which it is mixed. But the deficiency of carbonic acid occasioned by this, is about made up by the moisture which the carbonic acid gas carries off along with it. This renders the error, in general, trifling.

It will be proper to subjoin an example or two of the method of proceeding, to enable the reader to judge of the goodness of this test, and its value to the manufacturer.

The black oxide of manganese employed was subjected to analysis, and found composed of

Binoxide of manganese - - -	68.49
Peroxide of iron - - - -	11.85
Water - - - -	5.68
Earthy matter - - - -	13.98
	100.00

Experiment 1.

Put into the flask—	Water - - -	599 grains.
	Oxalic acid - - -	75
	Black oxide - -	50
	Sulphuric acid - -	184
Total - - - - -		908

Loss of weight 32.5 grains. It ought to have been 34.245 grains. Error 1.745 grains.

Experiment 2.

Put into the flask—	Water - - -	600 grains.
	Oxalic acid - - -	75
	Black oxide - -	50
	Sulphuric acid - -	154
Total - - - - -		879

Loss of weight 34.5 grains. It ought to have been 34.245 grains. Here the error is in excess, and amounts 0.255 grains.

Experiment 3.

Put into the flask—	Water - - -	600 grains.
	Oxalic acid - - -	75
	Black oxide - -	50
	Sulphuric acid - -	154.1
Total - - - - -		879.1

Loss of weight 35 grains. Here also the error was in excess, and amounted to 0.755 grains.

Let us take the mean of these three experiments:

Loss of weight by 1st	- - -	32.5 grains.
2nd	- -	34.5
3rd	- - -	35.0
		3)102
Mean	- - - - -	34 grains.

Here the error amounts to 0.245 grains, which is considerably less than one per cent. If, therefore, three trials be made, the error will be under 1 per cent.; so that the method is quite sufficient to indicate very nearly the quantity of binoxide of manganese in any ore. Now, it is the binoxide of manganese alone that is useful to the manufacturer; the sesqui-oxide and red oxide availing very little in the preparation of chlorine, for which almost alone the ore is used by manufactures.

I tried various other proportions of the ingredients, but found the preceding the best. I tried, also, the effect of rubbing up in a mortar the oxalic acid and black oxide. But the error is least when the oxalic acid is merely poured into the water, and the black oxide added before the acid is dissolved. Unless the sulphuric acid be added last, we cannot be sure of our weights. Rec. Gen. Sc. June, 1836.

Evolution of Light during Crystalization. A dull light sometimes appears while a solution is in the process of crystalizing, but the phenomenon has been considered as accidental and never exhibited at will, or as an experiment. A method has been pointed out by Henri Rose of Berlin, by which this light can be produced at any time.

Put two or three drams of arsenious acid, of a vitreous aspect, in a clear glass matrass, and sprinkle it with an ounce and a half of non fuming, common hydrochloric acid, and half an ounce of water. Heat it to ebullition, let it boil ten or fifteen minutes, then cool it as slowly as possible by gradually lowering the lamp or removing the heat. If the crystals begin to form in a dark place, the creation is accompanied with a vivid light, and the formation of each little crystal is attended with a spark. If the vessel be shaken a great number of crystals are suddenly formed, and as many sparks produced. If a larger proportionate quantity of the materials be taken, such as an ounce or two of arsenious acid, the light, at a favourable moment, will, on shaking the bottle, illuminate a dark chamber. This power of giving light sometimes continues two or three days in succession, but becomes very faint, depending evidently, on the continuance of crystalization, and not on the electricity of friction by agitation.

If the hot solution be suddenly cooled so as to produce a pulverulent mass of the arsenious acid, no light, or at best, a very feeble one, will be seen. The crystalization of sulphate of potash has been most frequently observed to emit light, but always accidentally, and never perhaps in the *pure* sulphate.

Arsenious acid is known to exist in two different isomeric conditions. It is either transparent and vitreous, or porcelainous and opaque. After fusion it is quite transparent, but in time becomes milk white and opaque, without any increase of weight. Both the specific gravity, however, and the solubility in water are different in these two states. In the opaque acid, commonly used as rats bane, no light has been observed by the author, or at best, a very feeble one, on slow cooling.

The cause of the evolution of light in the case now described, is considered by Rose as unknown, and in need of additional facts to render it intelligible. Berzelius remarked the appearance of light during the crystalization of fluoride of sodium, in a liquid which held that salt in solution.
Jour. de Pharmacie. Avr.

Decomposition of Sulphates by Oxalic Acid. M. Vogel of Munich, has ascertained that oxalic acid will decompose the sulphates of iron and copper so far as to set free the whole of the sulphuric acid, thus proving that it has a stronger affinity for the oxides of iron and copper, than sulphuric acid has. Its decomposition of gypsum, attributed to its affinity for lime, is well known. It is probable also that oxalic acid effects the complete decomposition of the sulphates, whose bases are the oxides of zinc, manganese, cadmium, &c. The oxalate of the oxide and oxidule of iron is a yellow powder, almost insoluble in water, and which heated to redness in a closed vessel, leaves the protoxide and carburet of iron. The oxalate of copper is a clear blue powder, insoluble in water. Heated to redness it yields metallic copper mixed with the protoxide. Idem.

Spirit of Wood. Damas and Peligot, have lately discovered a very remarkable product which they have named *Spirit of Wood.* It resembles very closely alcohol or spirit of wine. Treated with four times its weight of sulphuric acid it furnishes an ether which has precisely the same composition and density; and with various acids, benzoic, acetic, oxalic, &c. it yields as many different ethers, for which these gentlemen give exact formulæ. Its chemical agencies and properties appear to be quite as certain and well defined as those of alcohol, and it is presumed that ethers may be obtained from it which alcohol does not yield. Spirit of wood, purified, is already on sale, at Lemire's, Rue de la Verrerie, No. 19, Paris. Recuiel Indus. Avril.

Note on the Assay of Gilded Ware by the Wet Process. By H. Bouligny, *Assayer at Evreux.* The art of assaying the precious metals or determining their proportions in alloys, so long stationary, has within a few years made immense progress. M. Gay Lussac, in reducing to form his method of assaying by the wet process, has, if we may so term it, established the limits of this art in relation to silver. This process is nevertheless not generally adopted, notwithstanding its precision and other advantages. The application of this method to the analysis of gilding begins also to spread. It is thus practised: Boil the alloy in a mattrass with nitric acid, and precipitate the silver by the normal solution. The proportion of silver being known, dissolve the chloride of silver in ammonia, and the gold, which is insoluble in that alcali, is recovered in the usual way, and finally weighed.

This process, which is very exact when the alloy contains no tin, appears somewhat complicated to assayers who are not accustomed to chemical manipulations. That which I propose, is founded on the same principles and will appear perhaps of easier execution as it does not require the use of ammonia.

Take a quantity of the alloy containing about 1000 of fine silver, boil it ten minutes in a ground mattrass with 30 grammes of nitric acid at 22°, decant with care into a ground flask of the capacity of about 250 grammes; boil the alloy again five minutes in 15 grammes of nitric acid, at 36°, and decant with equal care this solution into the flask; pour into the mattrass 30 grammes of distilled water to remove all the nitrate and add it to the two former solutions. The flask which contains them is to be stopped and set aside. If any particles of nitrate of silver should adhere to the orifice

of the mattrass they must be carefully removed and added to the solution in the flask.

Fill the mattrass with distilled water, and reverse it in a crucible to collect the gold which must be dried and weighed. This weight is that of the gold contained in the alloy, which must be brought to unity by the rule of proportion. If, for example there were 1114.82 of alloy and 4 mill. of gold have been obtained, the weight of this metal in 1000 would be the fourth term in the proportion 1114.82 : 4 : : 1000 : x

$$x = \frac{1000 \times 4}{1114.82} = 3.588$$

The flask containing the solution of silver and copper, will be marked as an assay for silver, and the operation will be completed.

If the alloy contain tin, which would be known by the presence of a white powder at the bottom of the mattrass, this process would by no means answer. Recourse must then be had to cupellation and parting.

In terminating this note, I ought to observe, that this process is applicable only to gilding, which contains as a minimum of gold 150 to 1000 of alloy.

Annales de Chim. Nov.

Patent Rotary Printing-Apparatus. A patent has recently been taken out by Mr. Rowland Hill for a Rotary Printing machine. The types are imposed* upon cylinders, to which they are firmly attached, and of which, except the marginal spaces, they occupy the whole surface. The pressure is given by blanket-covered cylinders of the ordinary construction.

The most important advantages of this arrangement are stated to be, first, That as the revolving type cylinder is constantly receiving its ink in one part of its revolution, and constantly impressing the paper in another part, the action of the machine is unceasing; whereby a saving of time of about three parts out of four is obtained in comparison with the ordinary printing machines, when moving at the same velocity; because in those machines the backward motion of the form,* and the laying on of the ink, suspend for the time the process of printing. Further, as the motion of the type in this machine is continuous instead of reciprocating, the speed has been increased without difficulty or danger; and by this additional velocity, combined with the saving of time just described, the rate of printing is brought to about ten times that of the ordinary perfecting machines, i. e. those which print the sheet on both sides before it leaves the machine. Secondly, the reciprocating motion of the heavy form, inking table, and inking rollers of the ordinary machine entails such a loss of power and time, in comparison of the rotary motion which is here substituted for it, that it is believed, from careful observation, that, notwithstanding the great increase in speed, any given quantity of work will be executed at the expense of about one-eighth of the power required in the ordinary machine.

The facilities provided for fixing the type, detaching parts for correction, applying the ink and regulating its supply, are said to be fully equal, if not superior, to those of other machines.

Compared with the rapid machines used for printing the daily newspapers, the rotary machine will print two sheets on *both* sides with accurate register, while they print *one* sheet on one side with defective register.

Lond. Mech. Mag.

Improvements in Steam Carriages on Common Roads. We noticed in the preceding volume of this Magazine, two inventions of M. Galy-Caza-

* These words are used technically.

lat, which were designed for the improvement of steam carriages. We have since learnt, by a communication from the inventor, that they are part only of a series which has for its object the accomplishment of a problem in which so many have failed, and so much capital has been unproductively expended—the construction of a safe steam carriage, for the conveyance of passengers at a desirable velocity on common roads, which shall be perfectly safe from accidents by explosion, &c.

After a long and careful examination of the subject, and many experiments, on a full scale, M. Galy-Cazalat decided, that the following ameliorations were all desirable in the most improved carriages yet known, and most of them necessary; these he conceives he has perfectly accomplished in his steam carriage,

1. An arrangement by which the liability of the axle-tree-crank to break is diminished.

2. A mode of suspension of the engine, &c., which prevents its action from being disturbed by joltage.*

3. An apparatus for guiding the carriage, by means of the steam itself, with great facility.

4. An hydraulic break for diminishing the velocity, and, when desirable, entirely stopping a steam carriage, upon a declivity.

5. A steam-generator, of simple construction and little weight; with a fire place in which coal may be used as a fuel without giving out smoke.

6. An apparatus of great simplicity and of easy application, by which explosions of steam generators and boilers may be, at all times, *prevented.*†

7. An apparatus, also of great simplicity, and incapable of derangement, by which the water surface in steam generators and boilers is constantly maintained during the working of the engine at the same level.‡

It will be evident to all who understand the subject, that supposing M. Galy-Cazalat has succeeded to the extent which he describes, he has removed nearly all the more important impediments which have up to this moment obstructed the progress of this valuable application of steam power.

Mag. Pop. Sc.

Progress of Civil Engineering.

Health of Cities.—Improvement of London.

The immense importance of an ample supply of good water and the free circulation of pure air, to the inhabitants of cities and towns, is now universally acknowledged. During the prevalence of an epidemic, it is almost the dictate of *instinctive* wisdom to flee from the infected region, and seek for safety in places where the air and the water are uncontaminated. The preservation of the public health is the absolute duty of those who have the control of public affairs; and nothing within the range of this duty is of more vital consequence than to guard the purity of those elements that feed the flame of life in every human bosom, and regulate the functions which render the food we eat either nutritious or injurious.

* Examined and approved by the Institute of France, and rewarded with their gold medal, in 1833.

† Examined, tested, and approved by *La Sociétié d'Encouragement* of Paris, and rewarded with their large gold medal, in December, 1835. Described in p. 395 of the preceding volume of this Magazine.

‡ Described p. 397, as above.

To the improvements that have resulted from the progress of knowledge in the modes of eating, drinking, breathing and clothing, may be ascribed that remarkably increased longevity which is evident in many of those cities and countries where civilization and science are in the highest stages of advancement. Our American cities are increasing with a rapidity almost unknown, and, there is much reason to fear, without a due regard to the safety, health and comfort of their future inhabitants. That our climate is not, in general, so favourable to sound, robust health, as that of Europe, no one who has carefully observed the appearance and manners of the great mass of the population in both quarters will be disposed to deny. And yet, whoever compares the maps of the thickly settled, and regulated portions of our principal towns with those of European cities, will be struck with the far greater *paucity of open space* presented by the former.

The modern parts of London have been laid out with a most judicious regard to *good breathing*; but the supply of that great metropolis with good water, is still a desideratum which occasions much anxiety to all who are led by science and humanity to engage in schemes of improvement.

The river is still the chief source of supply, and whoever reflects upon the amount of feculent matter which must pass into that stream from a million and a half of inhabitants, will be prepared to admit the difficulty in devising any mode of effectual depuration.

"If the Thames water, (according to Dr. Bostock, who communicated the result of his interesting inquiry to the Royal Society in 1829,) be suffered to remain at rest, completely undisturbed, for a period of many weeks, fermentation will take place, in consequence of the presence of the softer portions of human ordures; the liquid will become clear, with the exception of a small portion of insoluble sediment; it will lose all unpleasant smell, taste, and colour; and present, instead of animal impurities in solution, an increase of its ordinary saline contents. This increase is to the extent of between two and three times, with regard to chalk, or carbonate of lime; of between five and six times, with regard to gypsum, or sulphate of lime; and of twelve times the usual quantity, with regard to common salt, or muriate of soda. By this change in the relative proportions of its saline contents, the water ceases to be soft, and becomes hard, inasmuch as each pint of it is found to contain four grains and $\frac{36}{100}$ of saline matter. Supposing, therefore, that the companies were to establish reservoirs of such magnitude as to allow the water to be lodged undisturbed therein, during a period of time sufficiently long for the depurative process by spontaneous fermentation to take place, which is to destroy all animal impurities in it, they would still supply the public with what, although clear and inodorous, would contain enough of chalk and plaster of paris to multiply, and render more severe, the various and innumerable degrees of derangements of the stomach and bowels, which so generally prevail in, and are almost peculiar to, this metropolis."*

No process of filtration, whatever may be the materials employed in clarifying, can deprive water of the ingredients that are chemically dissolved in it. "Would any one, knowingly, and with cheerfulness, drink a tumbler of water from a river spring, which should have previously run through a succession of cess-pools, and afterwards been filtered through sand and gravel, because it may then appear clear and transparent? Yet such is the case with

* Architec. Mag., Aug. 1836.

those, collectively, who drink, in some way or other, the Thames water of the London district!"*

The report of a committee "appointed at a general meeting held at the Right Hon. the Earl of Euston's, M. P., in Grosvenor Place, on the 3d of March, 1836, for the purpose of taking into consideration Mr. Martin's plan for rescuing the Thames river from every species of pollution; for the improvement of the wharfage, the establishment of two great public walks, and for other objects of public utility and importance," has the following suggestions.

"What, then, are the conclusions to be derived from the various parts of the present statement in reference to the supply of water in London? They are as follows:—

"*First*, That the water of the Thames, in front of London, is *always* in a most intense state of pollution.

"*Secondly*, That the process hitherto adopted for purifying it (subsidence) has proved insufficient, and leaves the most objectionable impurities still behind in the water.

"*Thirdly*, That even a more effectual process (fermentation, supposing it to be adopted, notwithstanding the great waste of time and money which it would entail) would only substitute one evil for another, as far as the health of the consumers is concerned.

Fourthly, That the most perfect, even, of all the processes of purification (filtration,) were it practicable, would not free such polluted water as that which we derive from the river (where it passes through London) from all its disgusting and injurious properties.

"And that, therefore, the only real remedy is to adopt the plan which turns away from the river the numerous streams of impurities that flow into it at present. And that the evil to be thus remedied is one fully, experimentally, and mathematically demonstrated; one which is of most serious injury to the health of a million and a half of the King's subjects; one, in fine, to which the public authorities cannot much longer refuse their most earnest attention."†

"It was given (says the Report) to the genius of Mr. J. Martin to devise the simplest, as well as the most completely effectual, plan for affording, at once, all that the public require, without injury to the rights and interests of the water companies, or interference with them; but, on the contrary, with manifest benefit to them, by saving any further outlay of capital, which they might think themselves called upon to employ in fruitless endeavours to satisfy public opinion. This plan may be defined in a single sentence; it consists in diverting, altogether, from the river every possible source of pollution within the London district; so that the water supplied from it to the inhabitants by the existing water companies shall become as unobjectionable as a noble river in its natural state ever offered to man; for, according to Dr. Bostock's evidence, given before the royal commissioners in 1828, The water of the Thames, when free from extraneous substances, is in a state of considerable purity, containing only a moderate quantity of saline contents, and those of a kind which cannot be supposed to render it unfit for domestic purposes, or to be injurious to health."

"*The manner in which Mr. Martin proposes to accomplish this object is by the construction of a close Sewer,* 20 *feet wide, and of adequate depth,*

* Arch. Mag. Aug. 1836.

† Ib.

along both banks of the river, commencing on the north near Milbank, and proceeding towards the Tower, round which it will pass, if required, to terminate near the Regent's Canal; while that on the south, beginning at Vauxhall, and proceeding in the direction of Rotherhithe, is intended to diverge thence, and terminate near the Surrey Canal. In order to dispose of the polluting drainage thus diverted from the river stream, and confined within these two sewers running parallel to the river, and with somewhat more than the declivity of its bed, Mr. Martin places two great receptacles at their respective terminations, so arranged and constructed, that the accumulation of all the drainage of the metropolis shall not be productive of the smallest annoyance or insalubrity to the nearest inhabitants. With this view, a system of ventilation will be established, both for the great sewers and the receptacles, which will prove equally simple and effectual, whether the committee adopt the one proposed by Mr. Martin himself, who has acquired much knowledge on this point, from having studied the ventilation of coal mines, or apply another, suggested by one of their members, equally competent for the task. In either case, however, the destruction of all noxious effluvia will be accomplished; a consummation which, coupled with the prevention (effected by the great parallel sewers) of the hitherto frequent inroads of the tide into the lower ends of the common sewers, and the consequent backing of the drainage in them, together with other measures for excluding all offensive smells through the street gullies, will render the London drainage more perfect, and the labours of the Commissioners of Sewers less difficult."

"*Erection of two lines of colonnaded Wharfs.*—Great and important as the first object unquestionably is, which Mr. Martin's plan is destined to accomplish, it is not the only benefit which the metropolis will derive from its being carried into effect. Although it seldom happens that, in adapting any very extensive remedy to a public grievance, or in undertaking a work of magnitude for the good of the people, local and individual interests are not in some degree injured or invaded, Mr. Martin's plan has the additional merit of being little exposed to such an objection. On the contrary, his plan, by the next object which it embraces, and which is, as it were, its natural consequence, is calculated to add to the value of most of the individual interests affected by the line of its operations. That object is the erection over the two sewers of a line of colonnaded wharfs, which will afford in front of the present wharfs additional room; increase the convenience of the merchant and the labourer; facilitate the operations of trade; give greater security to property landed from vessels and barges; improve the navigation of the river by the assistance of the subjacent sewers, which will constitute uniform embankments; and, lastly, add some portion of time to the number of hours during which the craft can deliver or take in their cargoes. The immense, and recent, advances which mechanical science has made in this country will enable the architect and engineer employed in the construction of these wharfs to take advantage of their uniform arrangement, and apply, through the engines required for the ventilation of the two great sewers and receptacles, either to the entire range of wharfs, or to any part of it where it may be required; the power obtained from atmospheric pressure acting on a vacuum, which has been so successfully applied, of late years, to cranes and other machines, and which, in this case, it is presumed, would be gladly adopted by the proprietors of storehouses, manufactories and breweries situated on the banks of the river, whereby another great advantage to those proprietors would be obtained from Mr. Martin's plan.

Respecting this useful application of mechanical science, the committee have the satisfaction of being able to refer to the opinion of one of their members, who is perfectly acquainted with the subject."

"*Formation of two extensive Quays, or Public Walks.*—But even this great metropolitan advantage, secured by Mr. Martin's plan, must yield the palm to another of a more popular and attractive nature, arising out of the accomplishment of a third object contemplated, also, by Mr. Martin. The committee, therefore, feel particular satisfaction in having further to report, that the same plan offers the most favourable opportunity of establishing, at a comparatively small expense, a magnificent promenade on each side of the river, unequalled in Europe, by the conversion of the roofs of the colonnaded wharfs, just described, into parapeted walks, to which the public will be admitted gratuitously on Sundays, and at the smallest rate of charge on every other day in the week. It is thus that the patriotic idea of Sir Frederick Trench will be realised, in respect to the erection of quays on the banks of the Thames, without the liability to the several objections which powerful individuals and public bodies made to the purely ornamental and architectural project of that gallant officer, who, with high-minded liberality, has declared Mr. Martin's plan to comprise more than his own, to be greatly superior in usefulness, to the public, and to deserve his utmost support. It is thus, also, that the wishes, so often expressed of late, by Parliamentary committees, of affording to the mass of the population, the luxury, salubriousness, and recreation of great public walks, in the very heart of London, will be accomplished at once, and on a more extensive scale than has ever before been contemplated."

"*Magnificent Architectural Promenade.*—It would be superfluous, on the part of the committee, to undertake to prove, that the establishment of a grand and magnificent public walk on each bank of the river, and behind a most crowded line of habitations running east and west of the metropolis, must be of infinite service to the neighbouring inhabitants, by affording them an opportunity of taking exercise in a reserved public walk (well calculated, too, for women and children,) and of enjoying a free and open atmosphere during the days and hours not devoted to labour, besides the benefit of a more direct intercourse. To these advantages they are certainly strangers at present, owing to their remote position from the parks, and from every other general resort of pedestrians; and, although a select committee of the House of Commons did recommend, in 1833, an extension and improvement of the embankment along the river from Limehouse to Blackwall, at a considerable expense to the parishes within that district, so partial a measure could only be useful to those whose residence is contiguous to the walk, without being of service to the inhabitants of the more central parts of the metropolis along the north bank of the river, where it is most required. On this point the committee have obtained the opinion of one of their body, who is a medical man, and who, having practised for the space of twenty years as physician to three extensive public institutions in London, principally connected with the relief of the sick poor of the river districts, has had numerous opportunities of ascertaining the effect of the impure water of the river, of the confined air of the streets and alleys adjoining to it, and of the want of exercise, on the general mass of the inhabitants of those districts. The committee specially refer to that opinion, in addition to that of the witnesses examined before the Parliamentary committee of 1833, principally because, in a question so entirely belonging to the consideration of public health, the long experience of a medical witness is more likely to carry weight with

those who have the protection of that health in their keeping. The want of means to take proper walking exercise, after a long day of laborious exertion, impairs the vigour of the body, produces among the working classes a morose and melancholy disposition, and engenders a spirit of dissatisfaction, which domestic privations are too apt to increase. Such feelings, in their turn, hurry their victims on to the resorts of the drunkard and the abandoned; where, if they imbibe not the spirit of discontent, they most assuredly sap the very foundation of their own health, and that of their future offspring. The committee, fully coinciding, also, in the sentiments expressed in the report of the select parliamentary committee, just alluded to, on public walks, refer with particular pleasure to the part of that report where the peculiar natural advantages which the metropolis might possess in respect to public walks on the banks of the Thames, are especially recommended to the consideration of the House of Commons."

"*Protection of Property.*—There is one more public benefit, which the establishment of a great walk on each bank of the Thames is calculated to secure, and which, hitherto, has not only remained unaccomplished, but has even escaped notice, namely, the protection of property on the river by night. It is a well-known fact, that, taking advantage of the many hundred craft which are left at night without a watch, and of the darkness, which conceals evil deeds, youthful thieves, and others, commit considerable depredations on the river. The brilliant illumination by gas of the great walks, and, if necessary, of the wharfs too, may be expected to put a salutary check to such guilty practices, and diminish the serious losses consequent thereupon; while the facility which the same walks will afford to the Thames patrol, of overlooking every movement on the river, will complete this, not insignificant, advantage to the public."

"*Formation of Public Baths.*—Connected, also, with the establishment of the great quays in Mr. Martin's plan, it will be found that an opportunity is afforded for the formation of large public baths, contiguous to the river, and so arranged that they shall not in the least interfere with the purity of the river stream. Respecting the necessity and utility of public baths, as far as regards the health and cleanliness of the working classes in London, it is scarcely necessary to cite any authority. Upon that important subject, however, as well as on the general effect which the extensive improvements and total changes effected, in the state of the river and its banks, by Mr. Martin's plan, will have in greatly promoting the salubrity of the populous districts near the Thames, the committee refer, with confidence, to the experience of the same individual whose opinion on public walks they have received, and who derives that experience from repeated observations made in London, and in all the principal capitals of Europe, constituting a valuable corroboration of the testimony of well-qualified witnesses given before the select committee on that subject."

"*Preservation and Application of Manure.*—The drainage received into the great receptacles, before mentioned, will be converted into manure, according to the method and practice very extensively adopted in China, on the continent of Europe, and of late years, also, in some parts of Scotland. This will be conveyed by well-devised arrangements, and under the influence of scientific measures, to different parts of the country, in covered barges, or properly constructed land-carriages. The value of this species of manure is almost incalculable. The best authorities place it far above every other, as containing in much greater abundance the very elements of which vegetable substances are composed, and on which their existence and growth

depend. By saving, therefore, the vast quantity of it which has hitherto been wasted in the metropolis, a *fourth*, and most important, benefit, that of fertilising, and rendering the land considerably more productive, will be conferred on the public, through the identical plan, which alone can secure to us the luxury of drinking wholesome and unpolluted water."

"*Financial Statement.*—On the financial part of a plan so simple, yet so gigantic in its results, a plan, too, which seems encompassed by fewer difficulties requiring pecuniary sacrifices, than are generally met with in great public schemes, the committee do not think it necessary to dilate at length. They have, however," produced an estimate (signed, *R. Dixon, Fellow of the Institute of British Architects*) by which the expenses of construction are upwards of £1,000,000 sterling; and another of income and expenditure, by which, after paying a dividend of 8 per cent., there appears a surplus balance of £206,000."

"The principal source of income is the manure, for which it is calculated to produce £200,000."

The report is dated London, April 23, 1836.*

"*Mode of ventilating the Receptacles and Sewers generally, and of destroying all noxious Effluvia from them. (Proposed by* N. Ogle, Esq.)—Anxiety will naturally be felt respecting the method by which the exhalations from so large a collection of animal and other impurities, amounting, at a moderate computation, to several millions of pounds, are to be rendered imperceptible to the senses, and innoxious to health. With a view of removing all such feelings, I submit the following explanation of this very essential part of Mr. Martin's plan:—

"Over the great receptacles fires will be placed, so arranged that no air shall reach them but that which has been drawn through all the ramifications of the sewers which intersect the ground beneath the streets. Thus a constant in-draft of atmospheric air will be drawn down into the great sewers, which will prevent the effluvia, now too commonly perceptible during particular states of the weather, from rising into the houses or roads. As the heat from these fires will be used to generate steam to work, by engines, the pumps which are to be employed for the double purpose of removing the manure from the receptacles, and of producing a vacuum in the hollow columns and architraves, by which atmospheric pressure may be used as a constant power at every warehouse, wharf, and manufactory; the establishment of such fires will afford three direct advantages. But, besides these, another important result will be obtained from them; for, by blowing the waste steam, which has passed the engines, into the lofty chimney placed over the receptacles, another vacuum will be created, which will draw up through the fires, with vast rapidity, the air commingled with the sulphuretted, and carburetted hydrogen, the carbonic acid gases, and whatever else may be evolved from the fermenting mass. In order to keep those gases always in motion, the atmospheric air extracted from the hollow columns and architraves, as before stated, will be ejected with force into the great receptacles, thence to be drawn through the fires by the action of the above chimney. By this process all effluvia will be destroyed."†

"*The Institute of British Architects' Letter to John Martin, Esq., dated* 43 *King Street, Covent Garden,* 3*d March,* 1836.—My dear Sir,—As you were yourself present at the last ordinary meeting of the Institute, held on Monday, the 29th of February, you are fully aware

* Arch. Mag. Aug. 1836.

† Ibid.

of the intense interest with which the members received the description of your admirable project for improving the discharge of the sewage of this metropolis, and relieving the Thames from those impurities which now so materially injure its waters, and affect the health of the inhabitants. I am, however, directed by a special resolution passed on that occasion, to present to you the thanks of the Institute for having submitted this important subject to their notice. Perhaps this acknowledgment may not be considered by you the less valuable, as proceeding from a body of professional men, whose practical experience enables them, even from so brief a view of the subject, to appreciate, in a general way, the important results which might arise from the adoption of a plan of such a nature. I am, my dear Sir, with every expression of sincere regard, yours very faithfully and truly,—*Thomas L. Donaldson, Honorary Secretary and Corresponding Member of the Institute of France.*"*

In a future number we may present the objections to the plan of Mr. Martin, which appear in the Architectural Magazine of London, with other suggestions for the improvement of the metropolis.

Mechanics' Register.

Coins and Medals. In a lecture lately delivered before the Society of Arts, Mr. Wyon described our present mode of engraving and multiplying the dies.

The selection of the best cast-steel for the purpose, he observed, was very important, and not sufficiently understood at present. The very fine steel that forms excellent gravers, and other cutting instruments, is unfit for the purpose, for unless hardened with great care, it is very liable to crack. The very coarse steel is also objectionable, as it acquires fissures under the die press. The object therefore is, to select steel of a medium quality—but the best steel may be spoiled, by want of skill in the smith who forges the dies.

When the rough die is brought to a table in the turning lathe, after being softened, the engraver commences his labours, by working out the device with the small tools in intaglio (sunk in), and when he has completed his work, the die is ready for hardening, which is, in itself, a very simple process—but one that is often attended with serious disappointment to the engraver, for it not unfrequently happens, that the labour of many months is either injured or utterly destroyed, from the steel itself being faulty or heated to excess. But supposing the original die, or as it is technically called, a matrix, to be uninjured by the process of hardening, it is reserved for the purpose of furnishing a puncheon (or a steel impression in relief.) For this purpose, a block of soft steel is turned flat at the bottom and obtusely conical at the top. In this state, its conical surface is compressed into the matrix by a blow from the multiplying die press: this gives us only the commencement of an impression, for the die becomes so hard by compression, as to require frequent annealing and re-striking before it is perfected. An impression taken in this way is called a puncheon, which, when the engraver has given it all the delicacy of finish existing in the original, is then hardened, and serves for the purpose of making dies for coining, by a similar process, viz., impressing the hardened steel into that which is soft.

* Arch. Mag. Aug. 1836.

The distinction, said Mr. Wyon, between striking medals and coins, is very essential, so much so, that I cannot avoid saying a few words on the subject. A medal is usually engraved in high relief, like those upon ancient coins, and it requires a succession of blows, sometimes forty or fifty, with repeated annealings, to make a perfect impression. A modern coin, on the contrary, is usually brought up with one blow, although with the disadvantage of the metal being harder. Standard gold, for instance, consists of one-twelfth of alloy: medals are usually made of fine gold; the engraving upon the coin is consequently made with a suitable degree of relief.

In striking a coin or a medal, the lateral spread of the metal, which would otherwise ooze out, as it were, from between the dies, is prevented by the application of a steel collar, accurately turned to the dimensions of the dies. The number of pieces which may be struck by one pair of dies, not unfrequently amounts to between three and four hundred thousand, but the average amount is much less. Mr. Wyon stated, that he remembered instances of twenty dies being destroyed in one day, owing to the different qualities of steel, and to the casualties to which dies are liable. There are, it appears, eight presses in the coining-room of the Mint, and he considers that the destruction of one pair of dies for each press per day, is a very fair proportion, though it is generally rather more.

It must be remembered, that each press produces sixty pieces per minute, without reckoning stoppages occasioned by changing of dies and other contingencies; and Mr. Wyon remarked, that in 1817, the daily produce of coins, in half-crowns, shillings, and sixpences, amounted to the enormous quantity of 343,000 per day, for three months: at that time all the eight presses were employed; but, on the 1st of last April, there were 125,000 pieces coined with five presses only. From the 4th of June, 1817, to the 31st of December, 1833, there were coined in sovereigns and half-sovereigns, 52,187,265*l.* sterling. Arcana of Science, 1835.

Great Blast at Craigleith Quarry. The long time in which preparations for a great explosion at this quarry had been going on, and the effects that were expected to result from the experiment, by a great saving of labour and expense, in at once dislodging a great mass of rock, and also lessening, if not altogether removing, the risk which attends the blowing up of small portions of rock from the flying fragments, rendered the experiment which took place on Saturday the 18th of October, 1834, a subject of much interest both in a public and scientific point of view. It having been intimated by bills that the blast was to take place at three o'clock, long before that hour crowds of people were proceeding along the roads leading to the quarry, and by three o'clock every place which commanded a view of the spot was filled with spectators. At the time when the explosion took place, there were no fewer than ten thousand persons on the grounds around the quarry; and curiosity was so much excited, that even the Castle-hill, and also on the Carstorphine-hill, a great many people were collected. At half past two o'clock, the conductor, inclosed in a block-tin tube twenty-six feet long and half an inch in diameter, was introduced into the bore. The depth of the bore was sixty feet, and seven and a half inches in diameter at the top, and six at the bottom, and was charged with 500 lbs. of Sir Henry Bridge's double-strong blasting powder. At half past three the match was lighted, and in three minutes the explosion took place. The report was not so loud as from a small piece of ordnance; but the effect

that was produced was highly satisfactory to all the scientific gentlemen present, and completely fulfilled the expectations that had been conceived by the projector. At the moment of the explosion, the great mass of rock appeared to those at a short distance to be forced upwards, and then to rend in large and deep fissures. It is calculated that upwards of 20,000 tons of solid rock have been displaced by this experiment. Ibid.

To prevent Ink becoming Mouldy. Add to each pint bottle of common writing-ink five drops of *kreosote:* it gives the ink a slight odour of smoked meat, which is by no means disagreeable, and effectively obviates its tendency to become musty. The same preventive applies with equal efficacy to Stephen's blue writing fluid.

Kreosote is a liquid extracted, by a circuitous process, from wood-tar, and may be purchased at the chemists' shops. Lond. Mag. Pop. Sc.

Stereotype plates of Iron. Mr. Zeigler, a printer of Blankenburg, in Brunswick, has printed a bible from iron stereotype-plates. The advantages of using this material for such a purpose are not stated. Ibid.

Ploughing by Steam. Some experiments have been tried at Red Moss, near Bolton, Lancashire, in the presence of Mr. Handley, M. P. for Lincolnshire, Mr. Chapman, M. P. for Westmeath, Mr. Smith, of Deanston, and other gentlemen interested in agriculture, with a new and very powerful steam plough, constructed by Mr. Heathcote, M. P. for Tiverton, About six acres of raw moss was turned up in the most extraordinary style; sods eighteen inches in breadth and nine inches in thickness being cut from the furrow, and completely reversed in position, the upper surface being placed exactly where the lower surface had been before. The possibility of ploughing by steam has thus been established, though the machine appears much too complex and costly for common purposes. Mining Journal.

Results of Machinery. Rapid as the increase of buildings in and about London has been, it is quite outdone by similar operations in Manchester, which is said to contain 700 streets more than it did four years ago. Ibid.

Ingenious piece of Mechanism. A very ingenious piece of mechanism, a miniature steam engine, has been constructed by Mr. Richard Corfield, a young man in the employment of Messrs. Gittins and Cartwright, at the Eagle Foundry, Shrewsbury. It consists of an engine not exceeding an half-inch cylinder, for the purpose of propelling a small steamboat, working its propelling shaft at the enormous speed of five hundred and fifty revolutions per minute—travelling a distance of thirty miles in one hour. The boiler is so constructed as to admit a spirit-lamp in the centre of the water, which affords sufficient fuel and steam for one hour. We should add, that the above is one of many extraordinary specimens of useful, though miniature and elaborate, works of art, made by Mr. Corfield. Ibid.

To hasten the flowering of bulbous Plants. Fill a flower pot about half full of quick lime, and over this put good mould, and in it plant the bulbs. Keep the earth always slightly moist, and press it down as it rises by the swelling of the lime. The flowers may thus be obtained in a very short time and at all seasons. Jour. Conn. Usuelles, Mars.

To deprive Icelandic moss of its bitterness. Steep it twenty-four hours in

an alkaline solution, then leave it a few hours in fresh water and the bitterness will be removed. Lye from wood ashes is very suitable. Ibid.

Improvement of Coffee. Many things have been proposed as substitutes for Coffee. Rye, and other grain, beans, peas, chicory, beets dried, &c. have in turn been proposed and their qualities valued. For some years past there has been sold in Paris, under the pompous name of *Coffee flowers imported from America*, a dark powder, a pinch of which really communicates to coffee a very agreeable aroma and allows of a little diminution of the quantity. I have examined this powder, and find it to be only sugar caromelized, or rather, almost completely chared. A small quantity of caromel produces precisely the same effect.

Chesnuts deprived of the envelope, cut into fragments of the size of coffee grains, dried and mixed with real coffee, roasted and ground together, are the best substitutes I have found. I have used it for thirty years. Some mix them in equal proportions. Bodin De La Pichonnerie. Ibid.

Preservation of Aliments. At a meeting of the Society for the Encouragement of National Industry in France, held March 16, 1836, Count de Lasteyrie announced the presence of Captain Ross, the celebrated navigator, and M. Jomard presented from him a tin box, containing preserved meat which he had brought from Cape Ferry, Lat. 72° 47′ N. and 90° Long. west of Greenwich, where it had been deposited by Capt. Parry, in August, 1824. The box was prepared by Gamble and Donkin, London, about 1820. This box, after passing through the West Indies, had been exposed to the Arctic regions eight years, being brought back in 1832.

Bull. d'Encour. Mars. 1836.

List of American Patents which issued in July, 1836.

		July.
513.	*Plough.*—Timothy Miller, Pittsburgh, Penn.	2
514.	*Fractured thigh apparatus.*—Samuel Woolston, Vincentown, N. J.	2
515.	*Plough.*—Isaac Snider, Mount Pleasant, Penn.	2
516.	*Hydrant.*—Sater T. Walker, Baltimore, Md.	2
517.	*Clover machine.*—William Loomis, Ashford, Conn.	2
518.	*Ice breaker.*—Michael Freytag, Philadelphia,	2
519.	*Anchor, cast-iron.*—James S. Stoddard, Palmyra, N. Y.	2
520.	*Cooking stove.*—Chester Granger, Pottsford, Vermont,	2
521.	*Rotary steam engine.*—Franklin Carpenter, Casenova, N. Y.	2
522.	*Staves for barrels.*—Cyrus McGregory, Newport, N. H.	2
523.	*Brick moulding machine.*—James Coppuck, Louisville, Ky.	1
524.	*Raising water by weights.*—David Hess, Shepherdstown, Va.	1
525.	*Sheaves for blocks.*—Cyrus Alger, Boston, Mass.	1
526.	*Cooking stoves.*—Asael Lear, Wendell, N. H.	1
527.	*Washing machine.*—William Newton, Warren county, Ohio,	1
528.	*Generating steam, &c.*—Isaiah Jennings, N. Y.	1
529.	*Combs of metal.*—R. A. Ives, Bristol, Conn.	1
530.	*Cleaning rags.*—George Carriel, Manchester, Conn.	1
531.	*Clocks.*—Joseph Ives, Bristol, Conn.	1
532.	*Hydrant.*—Sater T. Walker, Baltimore, Md.	1
533.	*Sowing grain.*—William C. Greenleaf, Andover, Maine,	1
534.	*Water wheels.*—Charles Kenzie, Troy, N. Y.	1
535.	*Road making.*—John S. Williams, Fulton, Ohio.	1
536.	*Churn.*—Davis Variel, Minot, Maine.	1
537.	*Mill stone dresser.*—John Tusk, Columbus, Penn.	1
538.	*Cutting straw.*—Mallory M. Marshall, Smithfield, Va.	1

		July.
539.	*Traveling trunks.*—Washington Sweetzer, Portsmouth, N. H.	1
540.	*Spirits of turpentine, extracting.*—Isaiah Jennings, N. Y.	1
541.	*Saddle.*—Otho W. S. Callahan, Staunton, Va.	1
542.	*Shingle machine.*—Tunis T. Burhyte, Barton, N. Y.	1
543.	*Woolen Yarn.*—William B. Walker, Hillsborough Bridge, N. H.	1
544.	*Trunks, valisses, &c.*—William Brown, Brooklyn, N. Y.	1
545.	*Rotary saw.*—Robt. S. Thomas, Rockingham, N. C.	1
546.	*Frieze window, &c.*—William Wooley, N. Y.	1
547.	*Locks for doors, &c.*—Almon Roff, N. Y.	1
548.	*Mill for grain, &c.*—Oliver Wyman, Watertown, Mass.	1
549.	*Andiron bars.*—James Cochran, Batavia, N. Y.	1
550.	*Tailoring, art of.*—James Wesler, Jr. Hagerstown, Md.	1
551.	*Mattresses, bolsters, &c.*—A. Salisbury, and J. Uram, Troy, N. Y.	1
552.	*Cooking stoves.*—E. Andrews and S. Austin, Bradford, N. H.	1
553.	*Distilling.*—A. R. Ken and H. Hoover, Waynesborough, Penn.	1
554.	*Saws, straining.*—E. Rathburn and W. Tinker, Conneaut, Ohio,	1
555.	*Force pump, double.*—John G. White, Dryden, N. Y.	1
556.	*Truss for hernia.*—Isaac Thompson, Brattleborough, Vt.	1
557.	*Cooking stove.*—Elish N. Pratt, Albany, N. Y.	1
558.	*Mowing machine.*—William Greenleaf, Andover, Maine,	1
559.	*Spark extinguisher.*—Gabriel Winton, Donaldsonville, Louisiana,	1
560.	*Plough.*—John M. Tilford, Murfreesborough, Tenn.	1
561.	*Awl haft.*—William Campbell, Gilsum, N. H.	1
562.	*Saddles, ladies'.*—William Jenkins, Ithaca, N. Y.	1
563.	*Fire place.*—Reuben Buck, Acton, Maine,	1
564.	*Chimneys, ovens, &c.*—Elisha Smith, Ithaca, N. Y.	1
565.	*Foot stove.*—Ezekiel Duball, Canaan, Conn.	1
566.	*Gun and pistol lock.*—Johnson Marsh, East Dorset, Vt.	1
567.	*Water wheel.*—Samuel Garrett, Londonville, Ohio.	2
568.	*Fires, extinguishing.*—Isaac Clowes, Norfolk, Va.	2
569.	*Brick machine.*—Calvan Waterman, Bath, Maine.	2
570.	*Locomotives and rail roads.*—Isaac W. Edgar, Wayne co. Ohio.	2
571.	*Bolts and spikes, drawing.*—Richard Haynes, Portsmouth, Va.	2
572.	*Gimblets, forging.*—De Grasse Fowler, Wallingford, Conn.	2
573.	*Ventilating stoves.*—Clement Woodward, Washington, D. C.	2
574.	*Saw mill.*—Samuel Goudy, Greensburg, Ken.	2
575.	*Grates, pendulum.*—Nathan Winslow, Portland, Maine.	2
576.	*Cooking stove.*—Philip C. Traver, West Troy, N. Y.	2
577.	*Heating rooms and ovens.*—John A. Pitts, Winthrop, Maine.	2
578.	*Feather dresser.*—T. P. Knowlton, Clermont, N. H.	2
579.	*Stoves.*—Howell Porlalee, Watervliet, N. Y.	2
580.	*Sewers of hydraulic cement.*—Obadiah Parker, N. Y.	2
581.	*Platform balance.*—John Horton, Madrid, N. Y.	2
582.	*Trashing machine.*—Aaron Parsons, Rockfield, Maine.	2
583.	*Vessels, construction of.*—Daniel Gerrish, Boston, Mass.	2
584.	*Lock for doors, &c.*—James McClory, N. Y.	2
585.	*Lever press.*—G. Guyon, N. Y.	2
586.	*Cooking stove.*—Elisha Lyman, Easthampton, Mass.	2
587.	*Horse power.*—Charles G. Gilbert, Leeds, Maine,	2
588.	*Water wheel.*—William F. Brown, Augusta, Maine.	2
589.	*Cotton gin.*—James McCreight, Winnsborough, S. C.	2
590.	*Smut machine.*—Rufus Dennison, Wilton, Maine.	2
591.	*Washing machine.*—James H. Littel, Skeneatelas, N. Y.	2
592.	*Ship thimbles.*—Prentiss White, Yarmouth, Mass.	2
593.	*Fly net for horses.*—Henry Korn, Philadelphia.	2
594.	*Wool and flax comber.*—William W. Calvert, Lowell, Mass.	2
595.	*Hat bodies, stiffening.*—Edward P. Spear, Lexington, Mass.	2
596.	*Smut machine.*—Jonas Pratt, Otsego, N. Y.	2
597.	*Neck stocks, shaping.*—Thomas Goodman, N. Y.	2
598.	*Marsh drainer.*—Jean Blanc, New Orleans, Louisiana.	2

CELESTIAL PHENOMENA, FOR DECEMBER, 1836.

Calculated by S. C. Walker.

Day.	H'r.	Min.					
24	16	57	Im	λ Cancri	,6,	N. 12°	V.69°
24	17	40	Em			300	358

Meteorological Observations for August, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	69°	86°	29.70	29.76	SW.	Moderate.	.8	Cloudy—shower.
	2	66	79	30.00	30.00	SW.	do.		Cloudy—flying clouds.
	3	64	74	30.00	29.95	SE.	Brisk.	.28	Cloudy—rain flying clouds.
☽	4	68	78	29.80	29.80	W.	Moderate.		Clear, do.
	5	64	77	30.06	30 10	NE.	do.		Lightly cloudy—clear.
	6	60	62	30 10	30 10	E.	Brisk.	1.00	Rain—Cloudy.
	7	63	70	30.00	29 95	SE.	Moderate.		Cloudy—lightly cloudy.
	8	64	80	30.00	29.95	W.	do.	.15	Cloudy—clear—shower.
	9	70	68	29.80	29.90	NE.	do.		Clear—floating clouds.
	10	55	70	29.95	29.95	SW.	do.		Lightly cloudy, do
	11	60	67	29.90	29.86	ES.	do.	.10	Cloudy—rain.
	12	56	72	29 86	29.90	E.	do.		Clear, do.
⊗	13	60	80	29.90	29.90	SW.	do.		Cloudy—clear.
	14	66	79	29.75	29.75	W.	do.		Cloudy—clear.
	15	64	70	29.86	29.90	NW.	do.		Cloudy, do.
	16	61	79	29 90	29.90	SW.	do.	.11	Clear, do shower,
	17	63	73	29.95	29.95	W.	do.		Clear—lightly cloudy.
	18	68	76	29.96	29.90	S.	Brisk.	.26	Clear—flying clouds, rain in night
	19	68	82	29 70	29 70	W.	do.		Partially cloudy—clear.
☾	20	66	71	29 90	29.90	W.	do.		Clear day.
	21	52	73	29.96	29.96	S.W.	Moderate.		Clear day.
	22	62	74	29.86	29.9[illegible]	W.	do.		Cloudy—clear.
	23	56	65	30.00	30.00	N.NE.	do.	.5	Lightly cloudy—do.—rain.
	24	59	70	30.00	30.05	NE.SE.	do.		Cloudy—partially cloudy,
	25	62	70	30.10	30.10	S.W.	do.		Cloudy—flying clouds.
☺	26	64	69	30 00	29 90	S.	do.	.17	Cloudy—rain.
	27	64	76	29.80	29.80	NE.	Calm.		Cloudy—clear.
	28	65	80	29.87	29.90	NW.W.	do.		Clear day.
	29	66	74	29.90	29.85	SW.	Moderate,	.5	Fog—cloudy—rain.
	30	62	69	29.70	29.70	NW.	Brisk.		Clear do.
	31	51	72	29.90	29.90	W.	do.		Clear do.
	Mean	62.52	73.42	29.91	29.91			1.25	

		Thermometer.	Barometer.
Maximum height during the month		86. on 1st.	30.10 on 5th, 6th, 25th,
Minimum	do.	51. on 31st.	29.70 on 1st, 19th. & 30th.
Mean	do.	67.97.	29.91.

JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

AND

MECHANICS' REGISTER.

DEVOTED TO

Mechanical and Physical Science,

CIVIL ENGINEERING, THE ARTS AND MANUFACTURES,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

DECEMBER, 1836.

Practical and Theoretical Mechanics and Chemistry.

Report of the Committee of the Franklin Institute of the State of Pennsylvania for the promotion of the Mechanic Arts, on the Explosions of Steam Boilers. PART II., *containing the* GENERAL REPORT *of the Committee.*

(CONTINUED FROM p. 306.)

71.—III. *Explosions may arise from defects in the construction of a boiler, or its appendages.*

This comprehensive division includes the discussion of the form, material and mode of manufacture of the boiler and of its appendages. The Committee have, however, no desire to interfere with the present or future state of the engine in these respects, further than as their duty requires them to give candidly to the public, their opinion of facts which are on record.

72. 1st.—*Form.* The influence of the form of a boiler in producing danger is of course very great; but to consider the numerous varieties of form would be impossible, even if their minute differences were known to the Committee. Every boiler should be required to stand frequent proofs as a test of its sufficient strength, but the working properties of each, with originally adequate strength, may be very different.

73. It may, in general, be remarked, that the old wagon-boiler of Watt, should be only used when very low steam is employed. The varieties of

the cylinder boiler, with or without interior flues, are in most common use in the steamboat-engines of this country. Of these, experience, both abroad and at home, has shown those without flues to be the more safe, and those with them the more economical. The heads of these boilers are, in this country, plane surfaces; in England, frequently, hemispherical, and in France, are required by law, to be of the latter named figure. There is no reason, however, to doubt the sufficiency of strength of the thick plane wrought-iron heads. Of the flues used, those in the smaller cylinders, which pass directly through both heads of the boiler are the more safe;* the flues passing through the convex surface, called L flues, and those which in the larger boilers return without passing through both heads, add nothing to the strength of the cylinders. Observation has shown that boilers with interior furnaces, or flues, commonly give way by the yielding of the flues, or by blowing off the heads. The tubular boilers of Woolf, have, but in one case, as far as the knowledge of the Committee extends,† been used in this country. Other forms of tubular boilers, in which very small tubes contain the water to be vaporized, have, in no case, to their knowledge, on full rial been found successful. The case is very different when, as in the locomotive boilers, the tubes are used as flues: and for obvious reasons. Such boilers have, however, only lately been applied to steamboats.

There does not seem to the Committee, evidence to show that any of these forms are essentially dangerous, though, as before remarked, there are grades among them as to impunity from careless management. From this remark, however, in some degree, should be excepted the L flue-boiler, which is incident always to a source of danger, hereafter to be pointed out. The remarks apply to single, or detached boilers.

74. Connected boilers, on board of steamboats, are incident to a source of danger which has already been pointed out, (art. 59, &c.) and after examining the remedies which have been proposed to meet these circumstances, the Committee are of opinion that they are of so varied a kind that the use of these boilers cannot be continued without certain danger, and therefore ought to be laid aside. Those at present in use could easily be detached, so as to connect only two boilers at most, and have a separate supply-pump for each pair.

75. In a former division of the subject, (II.) the Committee showed the great danger which is produced in a boiler by highly heated metal; any boiler, therefore, which has parts exposed to heat, without being in contact with water, is essentially defective. The L flue boiler is of this kind, though as it is only used in small cylinders, the exposure is not considerable.‡ The boiler with a steam-chimney presents an extension of this exposure, the boiler being continued up vertically at one end, so as to inclose the flue.§

* Experience seems to warrant this conclusion, and it does not appear probable that the difference of temperature between the flue and outer shell, even in boilers with interior furnaces, can be sufficient to injure a wrought-iron head, by the excess of the expansion of the flue. The case is different when cast-iron is used for a boiler-head.

† At Richmond, Virginia. See Burr on Explosions. Journ. Frank. Inst. vol. vi. p. 334.

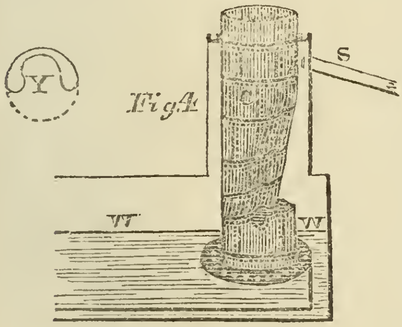
‡ A curious case of the overheating of a flue by the accumulation, and subsequent taking fire, of soot, is described by Mr. Hebert, in No. XI. of the Replies to the Circular of Committee on Explosions.

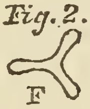
§ It should be recorded to the credit of the liberal minded patentee of this boiler, that he has afforded every opportunity to investigate its defects, and appears no sooner to have been convinced of the danger to particular parts of it, than he has applied his skill to produce a remedy.

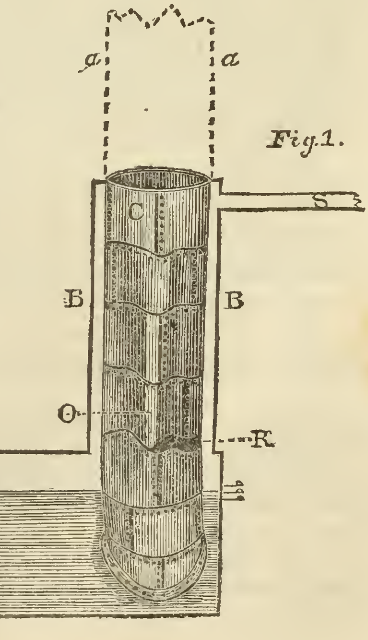
The idea is to economise the heat found in this flue, by heating the steam which is around it, and thus producing a small surcharge of heat which prevents condensation in the steam-pipe and cylinder. But the flues which the chimneys inclose, are thus exposed to become unduly heated. Two explosions which have occurred in boilers with steam-chimneys* have torn the same portion of the flue, and were so similar, as to show that they are to be attributed to an inherent defect in this construction. Indeed the presence of metal through which a highly heated draught is passing, while it is in contact only with steam, which cannot carry off the heat rapidly, is sufficient to warrant a decision against such a form of boiler, even if facts had not spoken so loudly in regard to it.

76. The Committee feel constrained to recommend to constructors to discontinue the making of connected boilers, of those with L flues, and with the extension constituting a steam chimney.

* In justice to the force of this concluson, the Committee feel it necessary to give extracts from the excellent accounts of the explosions on board of the Ohio and of the William Gibbons steamboats, by Thos. Ewbank, Esq., of New York. The first of these explosions occurred on the Hudson, in 1832, and the second in New York harbour in 1836. The annexed figures represent in plan and section the ruptured flue of the Ohio. WW, in the elevation, is the water line, C the flue around which the steam chimney is placed, and S, the steam-pipe leading from the steam-chimney. The rent took place from fifteen to twenty inches above the water line. This part of the flue is always exposed to the heated air from the horizontal flues which unite in the flue E, and is never covered by water. The line of fracture does not deviate more than six inches from a horizontal line. It is partly along a line of rivets, but chiefly through the centre of the sheets. In portions of one sheet, the metal is reduced from its original thickness of one-quarter of an inch, to one-eighth, and even to one-sixteenth of an inch. Jour. Frank. Inst,; vol. x. p. 226, No. XXIX. Replies to Circular, &c. The William Gibbons has one boiler of wrought iron, and similar in construction to those of "The Ohio" and " New England," but having a greater number of horizontal flues. The flue BB, within the steam-chimney, was collapsed so as to form a three cusped figure, as shown in fig 2. The rent R, thus produced, was four inches above the roof of the boiler. It was in one of the horizontal seams, and confined almost wholly to it, extending nearly three feet, or about one-third of the circumference of the flue. The flue was iron, one-fourth of an inch in thickness, and its thickness was not sensibly diminished previous to rupture. Jour. Frank. Inst. vol. xvii. p. 298. The fuel used ordinarily, was a mixture of anthracite coal and wood, but, on this occasion, it appears that the fire had been urged with quantities of wood.







77. It would be improper to leave this part of our subject, without calling attention to another point in the construction of boilers, which is to be avoided. It is the formation of small spaces intended to contain water and surrounded by fire.* All experience has shown that steam cannot be generated in small tubes without driving out the water, and these arrangements are equivalent to tubes; and besides being liable to the accumulation of deposites, they are exposed to have the water carried from them unless when under considerable pressure. The weakness of boilers of these irregular forms should never be lost sight of.

78. *2nd.—Material and manufacture.* As early as 1818 a Committee of the British House of Commons, on the authority of practical and scientific men whom they examined, recommended the disuse of cast-iron as a material for steam-boilers. This material has now so generally been abandoned, for this purpose, that remarks upon its defects are not necessary. Even the cast-iron heads for boilers which were used a few years since on the Mississippi are, the Committee believe, now giving place to wrought-iron ones. The materials in common use for steam boilers are wrought-iron and copper.

79. The Committee have made, by the arrangement stated in the preface to the first part of their report, an extensive series of experiments on the strength of the different varieties of wrought-iron and copper, manufactured for steam boilers in the United States. These experiments they hoped to have presented before making this report, but circumstances not now necessary to be made public, have prevented them from doing so, and they deem it inexpedient longer to delay on this account. They must refer, therefore, to a report, specially upon this subject, for a complete development of their views, as well as for information in regard to the proper thicknesses for steam-boilers, working under different pressures. They ought, however, to remark here, that the views usually entertained of the importance of working iron, have been entirely confirmed by them. The ultimate strength of a bar, or sheet of iron coinciding more nearly with the strength which the whole bar exerts to prevent a first fracture, or the bar or sheet being rendered more uniformly strong, and therefore better adapted for use in the construction of steam-boilers, the more it is worked. Iron which has been heated nearly to redness has its tenacity permanently injured, being affected, though in a less degree than copper, the weakness of which in such a case has long been well established.†

80. There can be no doubt that the strength of boilers may be diminished by constant and often unequal pressure, by which the material is injured so far as to give way under a less strain, than that which it may once have borne.‡ By ordinary wear, from oxidation, &c. their strength is necessarily much impaired.

81. When salt water, or spring water highly charged with saline matter, is used to feed boilers, iron is very rapidly acted on, and extreme care

* Ewbank on the explosion of the boilers of the steamboat New England. Jour. Frank. Inst., vol. xiii. pp. 292, 293.

† On both these points see also the remarks of Mr. Lester in Replies to Circular, &c. No. XVII. where the fact is stated both in regard to iron and copper, as resulting from his owne xperience.

‡ See Replies to Circular, &c. Nos. II. and XII. Col. S. H. Long and T. Bakewell, Esq.; also evidence of Mr. Bramah before Com. of House of Commons, 1817, Dodd's collection.

should be used in frequently cleansing them.* Careful owners would resort to more frequent proof by the forcing pump than in other cases. This would serve to detect corrosion in particular spots, to which the material is so liable. Copper boilers not being similarly acted on, are more safe in such situations, but there seems no reason to suppose that iron may not be safely used, with due precaution.

82. Instances of dangerous defects in construction, or arising from use, in boilers are but too well attested. The awful explosion on board the steamboat Helen McGregor,† by which more than thirty persons lost their lives, took effect by forcing off the cast-iron head of a wrought-iron boiler, throwing the boiler in the opposite direction: the head was known to be cracked, before the explosion occurred. It is not clearly made out whether this result was produced by a gradual increase of pressure,‡ or by the return to its level of the boat; which had been careened by stopping at a landing place. The steam was not let into the cylinder to propel the engine, when the explosion happened. The boiler was one of six connected boilers of three feet diameter. A cast-iron head should never be united to a wrought-iron boiler with flues,§ since, independently of the defects to which the metal is liable, the inequality of expansion is very likely to crack it.‖

83. A defect in a wrought-iron boiler head, was detected, by one of our correspondents, which we are surprised that any boiler maker should have allowed to pass. In turning the flanches by which the head is riveted to the cylinder, the iron was turned so sharply, as to crack it more than half-way through. This was one of four boiler heads belonging to the same set, found by Mr. E. W. Benton to be unsound. They could not have stood proving.¶

There can be no doubt but that the repairs to the boiler of the Caledonia were improperly made,** an iron plate having been fastened upon the boiler with copper rivets: this seems, at least in part, to have been the cause of the accident which subsequently occurred.

84. The idea seems formerly†† to have been entertained that dangerous explosions could not occur in wrought-iron boilers, which were merely rent without doing injury. It is almost needless to remark that the whole tenor of the evidence before the Committee contradicts the idea. Wrought-iron may even be separated into fragments, but the great source of danger is in the escape of the hot water, which, with the steam generated by it, produces death in one of its most painful forms.

85. Steam-boilers should not only be proved when originally made, but

* An instructive description of the action of salt water on iron will be found in the evidence of Professor Faraday before the Com. H. Commons of Eng. on steam navigation, 1822.

† Nos. III., IV. and XXI. of Replies, &c.

‡ Replies to Circular, No. IV.

§ See also explosion of Atlas, Replies, &c. No. VIII., and No. XXI., Car of Commerce, No. XXI.

‖ Evidence of John Taylor, Esq. before Com. of House of Commons. A cast-iron boiler head affixed in his shops to a wrought-iron boiler and originally proved with a pressure of 100 lbs. cracked by heat when only exposed to a pressure of steam of 20 lbs.

¶ No. VIII. Replies, &c. Boilers of Tally-ho Steamboat.

** Replies, &c. Nos, V., VI., VII., VIII., XXI.

†† Evidence before Com. of House of Commons. Dodd's Collection.

from time to time, to guard against their gradual wear, or accidental injury; and especially after every important repair made to them. In the intervals care must be secured by other means. These proofs have been recommended by most of our valued correspondents.

86. In the attachment of sheets of metal to each other to form boilers, and in the fixing of heads to boilers, constructors appear to have lost sight of the fact that the metal which is taken out for the rivet holes weakens the sheet, and that materially. In examining cases of explosion from direct pressure, and where no undue heating or special weakness has led to the result, the lines of rivets appear to determine the direction of the first fracture.* A very neat example of this was given in the bursting of an iron cylinder in the experiments of the Committee.† The head of the cylinder was forced off, carrying with it the metal which projected beyond the line of rivets. The rivet-holes had cut out rather more than half of the circumference of the metal forming the convex surface, along the circle passing through the centres of the rivet-holes, and thus had made the strength of the convex surface to resist rupture in a direction perpendicular to the axis of the cylinder, less than its strength to resist a rupture in the direction of the axis.‡

87. The exposure of joints, formed by the junction of boiler plates, to the fire, may be mentioned as liable to produce very rapid wear. The heat is not conducted off as rapidly as by the other parts of the boiler, and the lower sheet is exposed to rapid oxidation.

88. *3rd.—Appendages to the boiler.* Of these the principal ones have already been made the subject of remark, and recommendation by the Committee. The forcing pump, as one of the most important, deserves further notice in this place. It is not the intention to recommend any particular form of this pump, especially as the Committee believe that most commonly in use to be entirely adequate to all its objects. They may remark, however, that they consider several valves between the supply reservoir and the pump, and also between the pump and boiler, as of the greatest importance. They would further recommend to be placed on the eduction pipe a cock similar to that used in locomotive engines. A rod and handle connected with this should be placed in a convenient position, for the engine-man to ascertain, by turning the cock, if the pump is in action. Although this apparatus cannot dispense with due attention to the means of ascertaining the level of the water within a boiler, it may give notice of a defective supply, in time to apply a preventive, instead of a remedy.

89. The Committee consider that their remarks already made in relation to the mode of applying heat to a boiler have been sufficient. They do not see that the use of a fusible metal or fluid bath can be applicable, in practice, to the heating of a steam boiler, or would, if applicable, realize the advantages which have been claimed for them.

The recommendations embodied in the present division of the subject will be found carried out by the suggestion of appropriate enactments in the project of a law which is appended to this Report.

* Ewbank on the Explosion of the Boilers of the New England Steamboat. Jour. Frank. Inst., vol. xiii. p. 293.

† Report of Committee on Explosions. Part 1, p. 67. Jour. Frank. Inst. vol. xvii. p. 224.

‡ With an equal thickness of metal the strength in the former case would have been double that in the latter.

90. IV. *Carelessness, or ignorance, of those intrusted with the management of the steam-engine.*

It might be supposed that the fact once known that the engineer or fireman, who, from carelessness, or other cause, allows a boiler under his charge to explode, is in almost every case the first victim of the disaster, would produce care in those intrusted with the engine. But experience shows that this is not so; and the Committee, in proposing remedies, do but the duty which has been confided to them, and proved indispensable by examples, not to be mistaken or disregarded.

91. Familiarity with any sort of danger is so sure to produce callousness to it, and due caution is so apt to be considered as timidity, that a tendency to carelessness must be considered as the natural consequence of the situation of an engineer, or fireman. The subject of the causes of explosions in steam-boilers has been so little investigated, that men well versed in general science might be excused for ignorance of it, and steam-engineers should not therefore be too harshly or hastily blamed for what is incident to the nature of the subject, rather than the fault of the profession. The fact of carelessness or ignorance has however been so much insisted upon by our correspondents* that it must be assumed, and endeavours made to apply a remedy.

92. In the present state of general education in our country it would obviously be impracticable to insist that firemen, or even steam-engineers, should be versed in the scientific principles, which regulate the use of steam. The public have, however, a right to expect from employers, that their agents, who are intrusted with human life, should have a thorough practical acquaintance with the steam-engine, and to demand that those who have information of the sources of danger, should lay down plain rules for the guidance of those who have been referred to. As a guard against carelessness, the public have further a right to expect from the higher authorities, beginning with the chief engineers, and rising to the captains of steamboats and masters of shops, that they should exert all the moral influence which vigilance can produce. And from the law, that it should constrain all these, by appropriate penalties, to the discharge of their responsible duties.

This view the Committee have carried out in the project of a law which accompanies their report.

93. V. *Cases of collapse from a partial vacuum within a boiler, or its flues.*

These cases are so little applicable in the state of the steam engine in this country, that the Committee have postponed their discussion until the last.

It is certain that the boiler of a high pressure engine of proper strength for ordinary purposes, would also be able to sustain the action resulting from even the sudden formation of a vacuum within it. Low pressure boilers have been crushed by the pressure of the atmosphere when a vacuum has been formed within.† These accidents are effectually guarded against, as far as experience has shown, by a valve opening inwards with which Watt's boilers were provided.

94. A case of explosion at the Mold Mines, in Flintshire, which has

* Replies to Circular, &c. Nos. III., VIII., IX., XVII., XIX., XX., XXI., XXIII., XXVIII. Also, Remarks by "an Engineer," Philos. Mag. vol. i. &c. &c.

† Arago on Explosions. Annuaire du Bureau des Long. 1830, pp. 148, 169 and 170, also Journ. Frank. Inst., vol. v. pp. 404 and 412.

been circumstantially detailed by John Taylor, Esq.,* seems to prove that a rarefaction produced in the interior flues of a high pressure engine, may determine an explosion of the most violent description. The boiler which exploded, belonged to a set of three, feeding the same engine. The fuel used was bituminous coal. The furnace doors of all three of the boilers had been opened and the dampers of two had been closed, when a gust of flame was seen to issue from the mouth of the furnace of these latter, and was immediately followed by an explosion. The interior flue of this boiler was flattened from the sides, the flue and shell of the boiler remaining in their places, and the safety valve upon the latter not being injured. Mr. Taylor states it as probable, that the steam pressure at the time of this accident did not exceed thirty pounds, and that the water was at its proper height. He assigns as the probable cause which determined the collapse of the flue, the ignition of a mixture of gas from the coal with atmospheric air, the contents of the furnace not being carried up the chimney on account of the closing of the damper, by which a partial vacuum was produced. If the strength of the flue was but little more than sufficient to resist a steam pressure of thirty pounds, it is plain that the cause assigned is adequate to have produced the effect. It must be admitted, however, that the testimony of the fireman who escaped injury by the explosion, and who would have been subjected to all the blame of the accident, if any attached, his comrades having been killed, is of that kind which induces a doubt, whether the steam pressure and height of water, were exactly as stated.

The accident, however, suggests the precaution as necessary with coal, and with some kinds of wood, not to close a damper soon after fresh fuel has been added; if the furnace is within the boiler, the injurious effects may be very serious, even more so than in the cases already referred to, where the furnace is not so placed.

95. That a vacuum can occur within a steam-boiler which is in action, as has been propounded within a few years past, is a supposition too palpably contradicted by the facts of the case to require any examination here.

96. VI. Having closed the subject of the means of preventing explosions in steam boilers, the committee have yet to consider *whether it is possible to provide protection against their effects when they occur.*

The very respectable scientific and practical men who have at different times drawn the attention of the public to this matter, give undoubted authority to the suggestion. The means proposed are, by carrying the passengers in a separate boat from the engine, or by placing the boilers on the guards of the boat, and separating them from the parts occupied by the passengers, by a suitable bulwark.

97. In regard to the first of these plans, it has been attempted, and for want of sufficient patronage by the public, has been laid aside. Public opinion seems to set strongly towards precautions which shall render the engine safe, without crippling its power of giving speed.

98. The larger steamboats on our Atlantic waters have generally the boilers upon the guards,† but without any obstruction between them and

* On the accidents incident to steam boilers. Philos. Mag. vol. l. see also remarks upon the same by "a practical engineer," and by W. J. Henwood, in the same volume.

† We are pleased to see that a boat in which the boilers are placed upon the guards has been put in operation upon the Mississippi. This we trust is only the first of many of this kind to be hereafter constructed.

the inner parts of the boat. This affords but a partial security, diminishing probably the extent, but not preventing, the destruction of human life. That a bulwark of sufficient strength to protect against explosion, without adding too much to the weight of the boat, can be devised, the Committee are not prepared to assert positively, though they believe that it could.

99. Their views incline entirely to the protection of the hands, as well as passengers by rendering the boiler safe, and they fully believe that this may be done without incumbering the boats now in use, or requiring, in a majority of cases, an entire change of structure in the engine.

They have, however, to meet opinions which they hold in so much respect, introduced a clause in the proposed bill, annexed to this report, by which a bounty is, in fact, offered upon a boat constructed with suitable bulwarks between the interior part and the boiler.

100. The Committee having now completed their examination of the causes of explosion, with their preventives, as far as they are informed upon the subject, and made all the recommendations, which this examination has suggested to them, refer to the accompanying project of a law for the regulations of the boilers and engines of steam-vessels, for the means of carrying the more important of these suggestions into effect.

The provisions of this law refer only to the means of preventing the explosions of boilers of steamboats, or of affording protection against their effects. With the regulations in regard to the navigation or police of the boats, however important, this Committee do not feel warranted in interfering. They believe that the experience necessary to frame such regulations will be found in the appropriate Committees of Congress, upon whose attention they would respectfully urge the annexed provisions relating to the engine.

That such an enactment will contribute to the safety of the public, without interfering injuriously with those interested in the navigation by steam or in the manufacture of the steam-engine, is the deliberate opinion of this Committee.

Respectfully submitted,

In behalf and by direction of the Committee, by

ALEX. DALLAS BACHE,

Chairman of the Com. on Explosions, &c.

Presented to the Board of Managers of the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts, and approved, September 21st, 1836.

M. W. BALDWIN,

Chairman of the Board of Managers.

William Hamilton, Actuary.

A BILL

*For the regulation of the Boilers and Engines of vessels propelled in the whole or in part by steam.**

TABLE OF CONTENTS.

* The sections of this bill which are taken from that reported by the Committee on Naval Affairs, in the Senate of the United States, at the session of 1835-6, are marked by a note of reference to the sections of the latter.

4. Requires a certificate to the inspector from the owner or master of a steamboat, of the pressure of the steam intended to be used.
5. Makes provisions intended to secure the safety of boilers.
    - Art. 1. Requires two safety-valves.
    - 2. Provides for the graduation of the first.
    - 3. Fixes the maximum pressure to be allowed upon it.
    - 4. Provides for the regulation of the second.
    - 5. Requires the second to be inclosed so as not to be accessible except by the captain of the boat.
    - 6. Puts the second under the control of the captain of the boat.
    - 7. Regulates the least rise to be given to the lock-up valve.
    - 8. Directs the form of the lever of the valve.
    - 9. Provides for each two small cylinder boilers, one set of safety-valves.
    - 10. Requires a mercurial-gauge for low-pressure boilers, and prescribes its arrangement.
    - 11. Provides that it shall be open to examination by passengers.
    - 12. Requires a fusible metal apparatus to be attached to every boiler.
    - 13. Directs the fusible metal to be inclosed.
    - 14. Provides for its not being tampered with.
    - 15. Inspector to compound the fusible metal.
    - 16. Prescribes the composition of the fusible metal.
6. Requires an examination into the fulfilment of the foregoing provisions, by the inspector, previous to giving certificates.
7. Penalties for interfering in any way with any part of the apparatus provided for the safety of the boiler.
8. Prohibits more than two contiguous boilers to be connected by a water-pipe.
9. Penalties for the bursting of a boiler caused by a deposite.
10. Prohibits boilers in which the metal is exposed to heat without being in contact with water.
11. A thorough examination of the boilers, &c. required of the inspector. Proofs directed and proof-pressure prescribed. Certificates to be given by the inspector to be posted up under penalties prescribed. Fees of inspector.
12. Proofs, &c. to be made every six months. Circumstances under which a license may be forfeited.
13. Requires the pumps for supplying the boilers with water to be kept at work, when a boat is stopped for a temporary purpose. Penalty prescribed.
14. Qualifications for the office of inspector laid down.
15. Penalties for explosions when the master or engineer is engaged in gambling, or is intoxicated. Also from racing, &c.
16. A neglect to obtain or renew certificates as prescribed, to bar from the recovery of a claim for freight or insurance. Owners of boats to be in such cases responsible for loss, or damage, by explosions.
17. Penalties in case of explosion when the captain, &c., has neglected to have the required inspections made and certificates issued.
18. Provides a bounty for boats with boilers on the guards, and suitable bulwarks between them and the interior of the boat.
19. Inspector to be dismissed in case of making false certificates, &c.
20. Provides for the recovery of fines, &c. Proviso, that suits must be instituted within two years after the offence has occurred.

Section 1.*—*Be it enacted by the Senate and the House of Representatives of the United States of America, in Congress assembled*, That it shall be the duty of all owners of steamboats, or vessels propelled in the whole, or in part by steam, on or before the —— day of ——, one thousand eight hundred and ——; to make a new enrolment of the same under the existing laws of the United States, and to take out from the collector or surveyor of the port, as the case may be, where such steamboat or vessel is enrolled, a

* Sect. 1 of the bill reported in Senate U. S.

new license, under such conditions as are now imposed by law, and as shall be imposed by this act.

Sec. 2.*—*And be it further enacted*, That it shall not be lawful for the owner, master, or captain, of any steamboat, or vessel propelled in the whole, or in part, by steam, to transport any goods, wares, and merchandise, or passengers, in, or upon the bays, lakes, rivers, or other navigable waters of the United States, from and after the said —— day of ——, one thousand eight hundred and ——, without having first obtained from the proper officer, a license under the existing laws, and without having complied with the conditions imposed by this act; and for each and every violation of this section, the owner or owners of said steamboat, or vessel, shall forfeit and pay to the United States the sum of ——.

Sec. 3.†—*And be it further enacted*, That it shall be the duty of the President to appoint at such ports on the navigable waters, bays, lakes, and rivers, of the United States, as in his judgment will be most convenient to the owners and masters of steamboats, and vessels propelled in the whole or in part by steam, one or more persons who shall be practical mechanics, of competent skill, to make inspections of the boilers and machinery employed in such boats and vessels, whose duty it shall be to make such inspections, when called upon for that purpose, to give to the owner or master of such boat or vessel, duplicate certificates of all such inspections, and the said person, so appointed, shall, before entering upon the duties of said appointment, take an oath, before some competent authority, faithfully to discharge and perform the same.

Sec. 4.—*And be it further enacted*, That the owner, master, or captain of each and every boat or vessel propelled in the whole or in part by steam, shall certify, to said inspector, the greatest pressure, or total elastic force, of the steam intended to be produced in the boiler, which certificate shall regulate in the proofs, trials, and construction, hereinafter required.

Sec 5.—*And be it further enacted*, That each and every boiler of a steamboat, or vessel propelled in the whole or in part by steam, shall be constructed, and arranged, so as to comply with the following provisions:

1. There shall be two safety-valves, each of which shall be competent to discharge the steam made in the ordinary working of the boiler.

2. The first of said valves shall be graduated by the maker of the engine, and have stamped upon the lever, by which it is weighted, the pressure at which it will by calculation open, when the appropriate movable weight is placed at the several marks. Said pressure to be the difference between the pressure of the steam within, and atmospheric pressure on said valve.

3. When the movable weight exerts its greatest pressure, the total pressure upon said valve shall not exceed the pressure as certified according to the provision of the fourth section of this act.

4. The second of said valves, denominated the lock-up valve, shall be immovably weighted, the total pressure upon it not to exceed said certified pressure.

5. Said lock-up valve, with its lever and other attachments, shall be inclosed in a grated box, or otherwise duly arranged so that it can be raised, but not pressed down, except as above provided, upon its seat.

6. Said inclosure, or arrangements, shall be secured with a lock, of which

* Sect. 2 of bill, &c.

† From sect. 3 of the bill reported, &c

the captain or master of said boat shall alone have the key.

7. Said inclosure or arrangements, shall admit a rise in the valve of at least one-fourth of the diameter of its seat.

8. The lever of said valve shall be so constructed as on the rising of the valve, to diminish the effect of the acting weight, by at least one-tenth of the ordinary pressure derived from said weight.

9. When two boilers, each of not more than forty inches diameter, are connected by a steam-pipe, each pair of said boilers may be furnished with safety-valves, as described in this section, for a single boiler.

10. When the certified pressure provided in section fourth, does not exceed two atmospheres, each and every boiler shall be furnished with a mercurial-gauge, indicating by a float or rod, upon a duly graduated and marked scale, the excess of pressure within the boiler over atmospheric pressure, in inches of mercury.

11. Said gauge and scale shall be so placed as to be readily examined by any and every passenger on board of said boat.

12. Each and every boiler shall be provided with a fusible metal apparatus of suitable form and dimensions, to be applied to the boiler itself, or to its flues, at the place which may be considered that of greatest heat, or most liable to exposure from a deficient supply of water.

13. Said fusible metal shall be contained in a tube to prevent its exposure to pressure, and shall on softening, communicate an alarm by some suitable device.

14. Said apparatus shall be duly secured from being rendered ineffective, in the manner of the lock-up safety-valve heretofore provided.

15. The fusible metal hereinbefore referred to, shall be compounded by the inspector, who shall place it in the apparatus as aforesaid, and shall satisfy himself that the whole is duly arranged as heretofore prescribed; for which service he shall receive, on certifying the same, a compensation of——.

16. The said alloys shall be compounded according to the certified pressure of steam within the boiler, by the following table of parts, by weight, of the ingredients.

TABLE OF ALLOYS FOR USE IN CLOSED TUBES, AND WITH A METALLIC STEM.

Certified pressure in atmospheres.	Tin.	Lead.	Bismuth.	Certified pressure in atmospheres.	Tin.	Lead.	Bismuth.	Certified pressure in atmospheres.	Tin.	Lead.	Certified pressure in atmospheres.	Tin.	Lead.
1½	8	8	7.5	4	8	8	3.4	8	8	8.0	12	8	12.3
2	8	8	6.2	5	8	8	2.2	9	8	9.8	13	8	13.2
2½	8	8	5.3	6	8	8	1.2	10	8	10.6			
3	8	8	4.6	7	8	8	0.5	11	8	11.4			

Sec. 6.—*And be it further enacted*, That before delivering the certificate hereinafter to be provided for, the inspector, heretofore provided, shall examine the apparatus required by section fifth, and shall ascertain that all the provisions of that article are complied with.

Sec. 7.—*And be it further enacted*, That any person or persons whatsoever who shall wilfully overload or otherwise render inoperative said safe-

ty-valve or valves, or render ineffective said mercurial-gauge or gauges, by plugging up or stopping off, or in any other manner preventing their action, or shall in any manner, impair, or interfere, with the usefulness of said fusible metal apparatus, shall for every offence be subject to the penalty of —— dollars, and to an imprisonment at the discretion of the court, not to exceed ——, and in case of accident to said steam-boiler, resulting from said offence, by which life is lost, shall be deemed to have been guilty of manslaughter, and punished according to law for said offence.

Sec. 8.—*And be it further enacted*, That not more than two boilers of a boat, or vessel, propelled in the whole or in part by steam, and those immediately contiguous, shall have connected water pipes, nor shall the license heretofore provided for, be issued until the inspector has satisfied himself, and has certified, that the provision of this section is complied with.

Sec. 9.—*And be it further enacted*, That for each and every bursting of the boiler of a steamboat or vessel propelled in the whole, or in part, by steam, which shall occur from a deposite of sedimentary matter within a boiler, the master of said vessel, shall forfeit the sum of —— dollars; and that in case life shall be lost by the same, he shall de deemed to have been guilty of manslaughter, and shall be liable to prosecution accordingly.

Sec. 10.—*And be it further enacted*, That no boat or vessel propelled in the whole or in part by steam, shall be licensed until the inspector has certified on examination, that no part of the boiler of said boat is, ordinarily, directly exposed to flame, or to heated air from the draught, without the immediate contact of water.

Sec. 11.*—*And be it further enacted*, That it shall be the duty of the person who shall be called upon to inspect the boilers and machinery of any steamboat or vessel, in conformity to the provisions of this act, carefully, fully, and thoroughly, to inspect and examine the engine and machinery of said boat or vessel, and to state his opinion of their soundness: and he shall, moreover, provide himself with a suitable hydraulic pump, and, after examining into the state and condition of the boiler, or boilers, of said boat, or vessel, it shall be his duty to test the strength and soundness of said boiler, or boilers, by applying to the same a hydraulic pressure equal to three times the certified pressure which the boilers are to carry in steam; and if he shall be of opinion, after such examination and est, that the said machinery and boilers are sound and fit for use, he shall deliver to the owner or master of said vessel or boat, duplicate certificates to that effect, stating therein the age of said boilers, and the pressure of steam which may be carried by them, and which shall in no case exceed one-third part of the proof-pressure, one of which certificates it shall be the duty of said master or owner, to deliver to the collector or surveyor of the port, whenever he shall apply for license or for renewal of license: the other he shall, under a penalty of —— hundred dollars for every day that he shall neglect so to do while the boat is running, cause to be posted up and kept in some conspicuous part of the boat or vessel, for the information of the public; and for each and every inspection of the said machinery, and inspection and test of the said boiler or boilers, the said inspector shall be allowed and paid by the owner or master thereof, and before the delivery of said certificates, the sum of —— dollars.

Sec. 12.†—*And be it further enacted*, That it shall be the duty of the

* Sec. 5 of the bill reported in the Senate of U. S. with slight verbal changes.

† From Sec. 6 of the law reported in the Senate of U. S., the period for making the inspections of the boilers, &c., is here proposed to be extended to six months.

owners or masters of said boats or vessels, to cause the examination of the machinery, and the examination and test of the boilers, as provided in the sections of this act, to be made, at least, once in every six months; and to deliver to the collector or surveyor of the port where such boat or vessel, has been enrolled or licensed, the certificate of such inspection; and on failure thereof, he or they, shall forfeit the license granted to such boat or vessel, and be subject to the same penalty as though he had run the said boat or vessel, without having obtained such license.

Sec. 13.*—*And be it further enacted*, That whenever the master of any boat, or vessel, or the person, or persons, charged with the navigating said boat or vessel which is propelled in the whole or in part by steam, shall stop the motion, or headway, of said boat, or vessel; or the said boat or vessel, shall be stopped for the purpose of discharging, or taking in cargo, fuel, or passengers; he, or they, shall keep the engine of said boat, or vessel, in motion sufficient to work the pump, and give the necessary supply of water, under the penalty of —— dollars for each and every offence in neglecting or violating the requirements of this section.

Sec. 14.†—*And be it further enacted*, That no other than a practical mechanic who shall be of the age of twenty-one years, or upwards, shall have served two years in a steam engine factory, or general machine making establishment, and who shall have a thorough knowledge of the working of an engine, and shall produce satisfactory testimonials of steady habits, shall be employed as an engineer on board of any boat or vessel propelled in whole or in part by steam, provided that for every violation of this section, the owners or master of said boat or vessel shall forfeit the sum of ——— dollars.

Sec. 15.‡—*And be it further enacted*, That for every explosion which shall happen from any cause whilst the captain, master, or engineer shall be engaged in gambling, or attending to any game of chance, or hazard, or shall be intoxicated, or which shall happen from racing, or from carrying higher steam than the quantity authorized by the certificate, the owner of such steamboat, or vessel, shall be subject to the penalties provided for in the sixteenth section of this act; and the captain, master, or engineer shall be respectively subject to the penalties hereafter provided in the seventeenth section of this act.

Sec. 16.§—*And be it further enacted*, That any owner or master, of any steamboat, or vessel propelled in the whole or in part by steam, who shall fail to obtain ,or neglect to renew, the certificates of examination hereinbefore provided for in the several sections of this act, shall be barred from the recovery of any claim for freight or insurance that may accrue when without said certificate, and should any loss or damage to property, or injury to persons, in such case occur in consequence of the breaking of any part of the machinery, or bursting of the boiler or boilers, the owner shall be responsible to the full amount of said loss, damage, or injury.

Sec. 17.‖—*And be it further enacted*, That the captain or master of any boat or vessel propelled in the whole or in part by steam, which may not

* From Sec. 7 of the bill reported in the Senate, &c.

† The Committee propose this section as a substitute for the 16th section of the bill reported in the Senate. That section requiring an examination of engineers by the inspectors.

‡ From Sec. 13th of the bill reported, &c.

§ From Sec. 11th of the bill, &c.

‖ From Sec. 12 of the bill, &c.

have been examined, and obtained the certificates required by the several sections of this act, shall in the event of loss or damage to property, or injury to persons, occasioned by the breaking of any part of the machinery, or the bursting of the boiler, or boilers, be subject to a fine of not less than ——— nor more than ——— dollars, and an imprisonment of not less than ———, nor more than ———; and that in event of loss of life being the result of such accident, then said captain, or master, shall be adjudged guilty of manslaughter.

Sec. 18.—*And be it further enacted*, That any boat or vessel propelled in the whole or in part by steam, which shall have its boilers upon the guards of the boat, and shall have between them, and the interior of the boat, or vessel, a sufficient bulwark of timber, or other suitable material, so that passengers shall be protected effectually from injury in the event of explosion, shall be, on a certificate to the foregoing effect from the inspector heretofore provided, exempted from the payment of fees for the taking out of the license of navigation, and shall have remitted one half of the fees for proving and for other purposes of precaution heretofore provided. The fees remitted in such case to be assumed and paid to the respective officers by the United States.

Sec. 19.*—*And be it further enacted*, That for any false certificate, or one given without the thorough examination contemplated by this act, the inspector herein provided shall be dismissed from office, and fined not lessthan ——— dollars, nor more than ——— dollars, and imprisoned not less than ———, nor more than ———; and shall be incapable of ever being re-appointed to said office.

Sec. 20.†—*And be it further enacted*, That all penalties, fines and forfeitures imposed by this act, may be sued for and recovered in any court of the United States of competent jurisdiction within the district, or circuit, where the same may have been incurred, in the name of the United States—one half for the use of the informer, and the other half to the use and benefit of the United States.

Provided, That all suits, actions, or indictments instituted, commenced, or found, under this act, shall be commenced or found, within two years after the offence has been committed, or the cause of action accrued.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

Description of a machine for Milling Coin, invented and introduced into the Mint of the United States. By Franklin Peale.

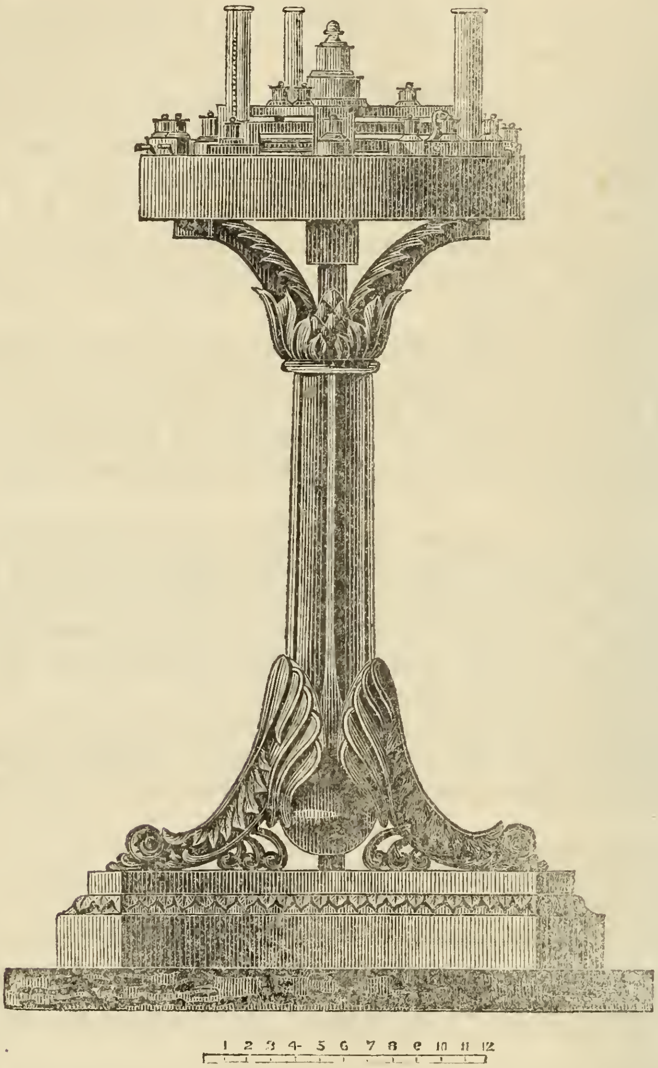
For the purpose of reducing manual labour, and expediting the processes of the Mint, I was induced, during the latter part of the last year, to make designs for the construction of a Milling machine, to be propelled by the steam power ordinarily employed in the Mint, a model of which I had the honour to exhibit at one of the late conversation meetings of the Institute. From these designs and model, the machines to which this communication relates, have been most satisfactorily executed in the workshops of the Mint, and are now in full operation in the coining department.

* Sec. 17th of bill reported, &c.

† Sec. 18th of bill, &c., with the addition of the proviso at the close of the section.

To those who are unacquainted with Mint operations, it will be well to explain, that the operation of milling has for its object, to throw up a thickened edge upon the *blanks* or *planchets*, previous to their being struck, by which means a better border can be given to the coin, with less labour or injury to the dies, it is also, sometimes employed to impress letters or ornaments upon the edge of the coins.

ELEVATION.



A classical tripod, of cast-iron, supports the table on which are placed the feeding tubes and dies; through the centre of the stand a vertical shaft rises from the room beneath, on the lower end of which is a *pulley* and its band, furnished with a clutch box, by means of which, movement is given, or arrested, as occasion requires. A winch handle may be applied to the hexagonal top of the axis, for the purpose of adjustment, or to propel the machine, if required, by manual force.

HORIZONTAL VIEW.

Upon the central axis is a wheel, furnished with two steel dies upon it periphery, the length of each of which corresponds to the circumference of the coin to be milled; and on the trilateral spaces of the table, are firmly screwed blocks for the outside dies, furnished with the necessary adjusting screws, by means of which the proper degree of pressure is given. Upon the axis immediately above the central wheel, an oval *cam*, or *eccentric*, is placed, for the movement of the feeders; this cam is set in *time* to place the blanks between the dies, when the extremities of the latter are opposite to each other. The feeders are *levers*, moving on centres, placed on each of the three arms of the gallows which supports the upper ends of the axis; which *levers* are kept against the cam by spiral springs, contained within a cavity at the centre of motion. A circular blade, or *pitcher*, as it is technically called, takes the lowest blank from the pile contained in the feeding tubes, and pushes it forward, at the required moment, and a light curved spring prevents its being thrown in advance of the movement. Nearly all of the parts are exhibited in the annexed views.

This machine is triplicate, and all its feeders may be put in motion at the same time, or any one of them, as occasion may require. Each division is capable of milling 200 pieces, or more, per minute, equal to 12,000 per hour, with the attendance of a boy only; and during this rapid operation, separates any defective pieces that may pass into the tubes. This machine has been in operation since February of the present year, and has given unqualified satisfaction in every respect.

Observations on Microscopic Chemistry. BY JNO. W. DRAPER, M. D. *Professor of Chemistry and Natural Philosophy, Hampden Sidney College, Va.*

1. One of the greatest obstacles to a more general study of scientific chemistry, is a prevailing opinion, that of all the various branches of knowledge, this demands more diversified resources, and entails upon those who prosecute it, an expenditure, usually beyond the means of private individuals.

2. It therefore is the duty of those who wish well to the science they cultivate, to point out the error of such an opinion. Within a few years there has been a complete revolution in chemical manipulation, or the mode of making experiments; a change, to which we are to ascribe the present rapid advance of the science. Operations on the large scale, are never performed, except by those who are public teachers, and here the necessity of rendering effect visible at a distance, calls for a degree of magnitude in experimenting, that unfortunately leads the pupil to conclude, that such pursuits can only be followed by the possessors of large fortunes, and even that they would meet with "almost impossibilities," except they were residents of cities. Those large retorts, and bells, and complicated stop-cocks, and furnaces, the innumerable company of vials, and tests, and electrical machines, and galvanic batteries, could not be purchased in the country. This is a conclusion to which those who have a predilection for these studies are often led,—an unfortunate conclusion, for it restrains many a one who would otherwise be an active and efficient labourer in the field. Now, there are few chemists, even among those who reside in cities, and have the disposal of well appointed laboratories, who could not communicate a large stock of highly useful information to their less fortunate brethren. A man, who for a number of years, has been engaged in all kinds of operations of repetition and research, must of necessity be acquainted with a number of simple succedanea, both in the shape of operations and instruments, which at times have obtruded themselves upon his necessities. With this view, I propose to offer my mite, in the hope that it may stimulate others, who are far better able to extend this kind of information.

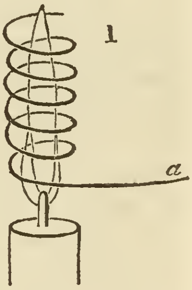
3. The specific properties of any kind of matter, are as well seen in a small particle as they are in a large mass. A piece of marble, not bigger than a pin's head, will furnish the same chemical results, as a piece of an ounce weight. Hence, if the operator possessed that delicacy, and tact which would enable him to work as well with the small quantity as with the large, his result would be equally striking, and equally true. Like all other sciences, in its infancy chemistry had a degree of roughness, which offers a remarkable contrast with the neatness and finish of modern manipulation; instead of those enormous alembics, and colossal retorts, which dignify the works of the earlier writers, we now give instructions to perform the same distillations in fragments of quill tubes; the blow-pipe has replaced the hundreds of blast, and forge, and reverberating furnaces, over which the alchemist toiled, by the sweat of his brow, not, alas, gaining his bread; and the grain weight and cubic inch have become the units of the laboratory, instead of the pound and the gallon.

4. The manipulation of microscopic chemistry, consists in the art of working with small portions of matter. It requires a degree of manual dexterity which practice alone can give, but which if once gained, is of vast importance to the chemist. It reduces, to an indefinite extent, the charges

and expenses he incurs in a series of experiments; and, what is equally valuable, there is a great saving of time. A few minutes will often put him in possession of the same facts, that on the old plan he must have been hours or days in acquiring. Again, there are often circumstances under which he would be compelled to work on minute quantities, as perhaps in the detection of a poison in the stomach, or in the analysis of a precious substance, and here if his previous habits had not accustomed him to operations on the small scale, he would soon find himself quite incompetent to perform his task. In this point of view, perhaps future chemists will hereafter assign a much higher rank to Dr. Wollaston than to Sir H. Davy, the simple, refined and delicate experimenting of the former, affording a more useful guide than the dashing brilliancy of the latter.

5. It is not many years, since the mouth blow-pipe was transferred from the workshop of the jeweller, to the laboratory; it has already become one of our most powerful and useful implements, giving a command over a range of temperature nearly as high as the melting point of wrought iron. Still later the simple candle or lamp has been employed, without any means of urging the flame, and when properly managed, its applications are also very extensive; to the chemical student, it is an invaluable substitute for all kinds of extensive furnaces, and therefore deserves to be thoroughly understood. As there are many parts of the United States, where oil is with difficulty obtained, and lamps scarcely ever used, I propose first to make a few remarks on the power and method of using a tallow candle, as a source of heat.

6. The range of temperature that can be commanded by a tallow candle, is by no means inconsiderable; it is well known that iron or steel filings sprinkled on the flame, are made at once white hot. And if a copper wire be presented to it, under certain circumstances, it will be fused in a few moments. This is a simple experiment, but one well deserving of repetition; so far however as I am aware, it has never yet been pointed out; it is striking, and perhaps in the hands of a skilful machinist, might have some useful applications. A thin copper wire, is to be bent into a spiral of six or eight turns, over a cylinder of wood, about the size of a black lead pencil; one end is left uncoiled as at *a*, to be used as a handle; the spiral is now to be put over the flame of a candle, whose wick has been fresh snuffed; it is to be arranged so as entirely to surround the flame, and held by the extremity *a*; the flame immediately, burns very dimly, and puts on a greenish hue, and the copper wire melts and falls down. So complete and perfect is the abstraction of the heat from the flame, that I doubt not that if a narrow tube were placed under similar circumstances, and a stream of water forced with great velocity through it, it would be an advantageous mode, if not the most advantageous, of applying flame as a source of heating liquids.



7. A great variety of experiments are required, respecting the fusibility of minerals or other substances, and the characters they display in the fire; these for the most part, may be made by paying due attention to the size of the fragment operated on, viz. that it shall be sufficiently small, and that the support on which it is presented to the flame, be as fine as possible, and of a highly non-conducting material. It is the perfect fulfilment of these conditions, that enables a simple candle flame to burn iron filings. A little

cone made of white clay, and having a very fine point, is excellent in these respects, and is useful also in blow-pipe experiments.

8. There are certain minutiæ to be attended to, in working with a candle, that should here be noticed. They arise from the candle burning with a flickering flame, from the wick becoming too long and smutty, and requiring continual snuffing. This last inconvenience, may, however, be avoided by a simple expedient. Suppose it was required to dissolve a certain quantity of any saline substance in boiling water, and that to effect the solution, would require the application of heat for several minutes. Having beaten the salt into small fragments, put it into a common vial, of such a size, that the amount of liquid shall not half fill it. Around the neck of the phial, double a strip of paper, the projecting ends of which are to be twisted into a handle, *a*. Now, if the candle be held in a vertical position, it will be found, that it would require continual snuffing at inconvenient moments; but, by inclining it at an angle to the horizon, as soon as the wick exceeds a certain length it projects beyond the edge of the flame, and is burnt off, by the continual access of atmospheric oxygen, and the candle never requires snuffing. In the operation before us, it will be found unsafe to apply the flame to the extremity of the phial, because nearly all phials are very thick in the bottom, and fracture would certainly ensue; but, by applying the heat an inch higher up, all kinds of solutions, distillations, &c., may be safely, cheaply, and expeditiously performed by this means. In the course of a few minutes, the liquid commences boiling, and the solution gradually proceeds; steam is copiously evolved from the mouth of the bottle, and the whole vessel attains a temperature which renders it inconvenient to touch; the advantages of the twisted paper handle are now apparent, since the vessel may be held in the hand, the elbow resting on the table, while steam is copiously rushing out of it, and all the phenomena of the solution distinctly seen.

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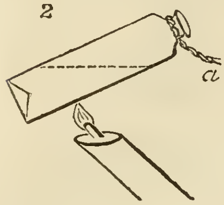

9. In this, as well as all similar operations with candles, and also with lamps, there is an important observation to be attended to—it refers to the distance between the bottom of the vessel, and the top of the flame. It might be supposed that a maximum of temperature would be reached by plunging the vessel into the flame; such, however, is not the case; a copious deposit of carbonaceous matter at once covers the surface, and the high radiating power of this coating, exerts a powerful cooling effect. Nor is that all; every thing like cleanliness is entirely sacrificed; if the fingers happen to touch it, they become soiled, and it is impossible to see the action going on in the materials employed. All these inconveniences are avoided by placing the vessel half an inch, or if the flame flickers much, a whole inch above its apex; the cleanliness of the vessel is insured, there is an abundant supply of heat, and the operator can distinctly see any kind of reaction going on in the materials. It may be observed that these remarks do not apply to the spirit lamp.

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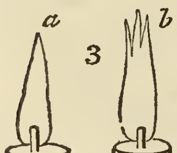
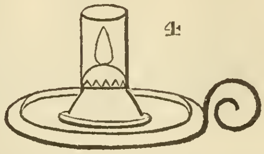


10. When a candle thus arranged, is burning as it ought to do, its apex is not a cone, as *a*, but is as represented at *b*, ending in a kind of three pronged fork; the point of maximum available temperature, being about half an inch from the tips of the prongs. In an appropriate, but very simple arrangement of phials, such as will be shortly pointed out, evaporation and distillation to a certain extent, may thus

be carried on over a candle; the distillation of water, or the making of strong nitric acid, are thus readily accomplished. Except, however, when the vessels are exceedingly small, it will not be possible to distil sulphuric acid, or mercury, too high a temperature being demanded.

11. Where oil is readily procured, the common oil lamp is a much more convenient implement than the candle, affording a more steady and constant flame, which can easily be protected from the agitation of currents of air, by a piece of sheet tin, two inches wide and three long, bent into a cylindrical form. This chimney ought to have its lower edge serrated, to admit a copious afflux of air, and at the same time to stand firm on the lamp. Sheet tin, or copper, or brass, can be readily cut by a common pair of scissors, and that elasticity which sometimes hinders a piece from retaining the shape into which it may be bent, is overcome, by making it red-hot in the fire.



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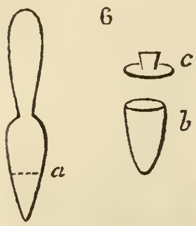
12. I have somewhere seen a description of a small portable furnace which is used by the Cingalese jewellers, and found it very eligible in experiments which demand the ignition of a larger mass than can be worked either with the simple candle, or blow-pipe. It consists of a shallow earthen tray; of the size and figure of a saucer, which is to be filled with saw-dust, or finely chopped straw. On the surface of this non-conducting bed, a little charcoal fire is raised, one of the pieces of coal having been previously ignited. The fire is urged by blowing *at* it, through a piece of hollow reed, or tobacco pipe stem, or even through a straw; there is a certain distance, at which the pipe has to be held, to produce the most powerful effect, this is easily determined at the very first trial, by a peculiar roaring sound that the blast makes among the embers; this distance varies from 2 to 6 inches, depending on the degree of ignition, and the force with which the wind is urged. Gold, silver, and copper, may be melted in this furnace, when the fire is about as large as one's fist, and the igniting and crucible operations required in mineral analysis, may be conveniently performed in it.

5

13. The bowl of an earthenware tobacco pipe, makes a suitable crucible for this furnace, the hole in the bottom of it being stopped by a pellet of clay. Persons, however, who reside where refractory clay can be procured, will find it convenient to accustom themselves to the manufacture of small vessels, such as crucibles, tubes, retorts, &c. And as knowledge of this kind gives a degree of independence to a chemist, affording him facilities for working without a long and vexatious delay in having to send to the cities for suitable implements, it is well for him to make himself master of it; the process for forming a crucible is as follows. A piece of wood, six or eight inches long, and of a suitable thickness, has one of its ends cut into a shape suitable for the inside of the vessel, it is finished off neatly with a file, and no projecting part, or asperities, left; it should be considerably longer than the height of the intended crucible. The clay is to be prepared, by picking out from it any little pebbles, grit, or any other impurity, and bring it by kneading with a due quantity of water, to the condition of a stiff homogeneous paste. A small cylinder of it, is then to be rolled out on a board, until it is about one-sixth or one-eighth of an inch thick, observing not to roll it out entirely on one side, but after having

passed the roller, (which may be a piece of stick rounded, or a common ruler,) two or three times on one side of it, to shave it up, by passing a knife between it and the board, and then turning it over, to roll it on the opposite side; by this means it is prevented from sticking to the board. The core *a*, fig. 6 having been slightly greased with lard, is then covered with a sheet of the clay, as high as *a*, the seam where the two edges meet is neatly united by pressure with the fingers, and also the bottom closed. Care must be had, that not too much clay be put on the core, or the work will be bungling and clumsy, it will therefore be evident, that the size of the sheet laid on, should be properly adjusted. The core can be removed without any injury, by clasping the crucible all round with one hand, and twisting at the wooden handle with the other. As the clay slips off, the pressure must be relaxed, for fear it should be crushed. A degree of polish may then be given, to the inside and outside, by rubbing them gently with a wet finger, and the upper edge neatly rounded off: and if necessary, a beak made as at *b*. No difficulty will be met with in thus making crucibles up to an inch high, and half, or three-quarters in diameter. A few lids for them, shaped as at *c*, should also be prepared.



14. In like manner, tubes may be moulded on a cylindrical stick, but when they are over a certain length, difficulties arise in slipping them off, a part of the clay moves, but the rest adhering, disfiguration ensues. For long tubes, and also for retorts, it is therefore better to form a core of bees-wax, by moulding it in shape between the fingers, the clay is then to be applied, and when dry, the wax is to be melted out. Those who are adepts at this kind of work, will have no difficulty, however, in moulding a retort on a piece of wood, cutting it into symmetrical halves, with a pen-knife, taking it off the core, and applying the cut edges again together; it is to be remarked, that the core must in no instance be anointed with too much grease; it will hinder cut edges joining, if it should get upon the junction.

15. Vessels thus made are very porous, and therefore unfit for many uses. They may be glazed, by covering them with a paint, made of a mixture of lime, borax and water, applied with a common brush. The greatest difficulty, however, in manufacturing them, consists in drying them thoroughly, without cracking; the desiccation must be very gradual, and equal; first, dry them in the sun, and then approach them slowly to a fire; some clays are more prone to crack than others, and the addition of fine sand to them is a great advantage; but the process of drying, must still be carried on cautiously. When once, however, they have been made red-hot, all further danger on this account is over; at a temperature slightly higher, the lime paint daubed on melts into a glass, which soaks into every pore and renders all quite tight.

16. To show the extensive application these homely little vessels have, I may remark, that I have seen one of them, a retort, whose belly was not larger than a school-boy's marble, and neck three inches long, when properly glazed, and charged with the carbonaceous matter that results on igniting cream of tartar in close vessels, filled with the green vapours of potassium, when placed in the furnace of sec. 12; a proof of its tightness and applicability.

17. Very useful glass vessels, for distillations, sublimations, &c. may be made out of apothecaries' phials. One of these will serve for a retort; and

another, with its neck cut off, for a receiver: the object of cutting the neck off, being to give entrance to the mouth of the other phial. The readiest way for a beginner to cut glass for these purposes, is by a hot wire laid on the place where it is desired to cut the vessel; in a short time the glass cracks, and the seam will follow the hot wire in any direction; should it refuse, however, to do so, it is because the wire has become too cold. Some kinds of glass are rather tardy in cracking, they may, notwithstanding, be forced by putting a drop of cold water on them, when they have become hot from the touch of the wire; but this expedient has the disadvantage of often starring the vessel.

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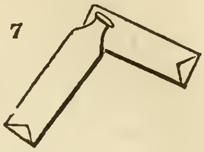

18. In the books, there are descriptions given, of different methods of igniting gaseous mixtures in close vessels, one of the most usual is by an electric spark; this spark may be procured from the machine, or by an electrophorus made of glass or rosin. There is a substance which, it appears to me, might be very serviceable for the construction of both these instruments. Common, strong, brown paper, is one of the very best electrics we possess, as the following experiments may prove. Take a piece of this substance, ten inches long and four broad, and holding it in the left hand by one end, lay it upon the right knee, placing the right forearm with a gentle pressure upon it. Draw it from between the knee and arm, replace it, and repeat the operation. Then, on approaching a knuckle to it, a spark an inch or two long will be projected from it, with a very audible crack. Or, if it be placed on the side of the wall, it will adhere there. Or, if when thus excited, it be brought over small paper figures on the table, they will dance beneath it. To the success of these experiments, two precautions are required; the paper must be dried before the fire, until it smokes, and the garments must be made of woollen cloth.

19. For attaining high temperature in the interior of jars and glass globes, there is no simple and effectual contrivance; this is yet a desideratum. The solar convex lens is excellent in its way, but it is too dependent on the weather for its action, and too expensive for common use: the igniting effect of a voltaic arrangement, is only to be taken advantage of by those who have powerful instruments at their disposal. Wherever the impression of a powerful heat, under ordinary circumstances is required to be observed, the blow-pipe is of very advantageous use. This instrument, in its simplest form, consists of a straight pipe terminating in a narrow, but neatly rounded aperture *a*. It may be made of almost any material; as of a reed, or a couple of quills slipped on one another; its essential part being the small beak, or termination, which ought to be formed of some infusible metal. On an emergency, the young chemist may make a very useful and excellent instrument, by taking two quills, as *c* and *d*, and slipping the one a short way into the other, and forming the beak, or termination of the extremity, of one of those patent silver pencil cases, which are now in such general use. This may be fitted air tight to the quills, by wrapping paper round it, and is much superior in its action, to many of the brass blow-pipes sold in the shops. These blow-pipes are generally bent, and those who are in the habit of using them consider that as an advantage; but in mineralogical

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investigations, there are several advantages in the instrument being straight, the flame is thrown from the operator's face, and he has a better view of the action going on in the materials with which he is experimenting. When glass tubes are to be had, a temporary but very excellent blow-pipe may be made, by drawing out one end of a piece, four or six inches long, to a point, and cutting it off, until the reduced aperture is of a proper size; it requires however, care to be taken, that the fine extremity be not held in the flame, except when the current of air is passing through it, or the temperature suddenly rises, the glass fuses, and the pipe becomes sealed.

20. Occasionally, experiments have to be made when a more exalted temperature has to be applied to a glass vessel, than can be conveniently attained by means of a candle or lamp. If, for instance, it were required to boil an ounce or two of the common brown sulphuric acid of commerce, so as to render it colourless, the operator would not find it convenient to make use of any of the arrangements hitherto described, for there is always more or less risk, in exposing a glass or phial to the naked fire; a risk, too, which it is not desirable to incur, when so highly corrosive a substance as hot sulphuric acid is concerned. The danger of fracture, and its consequences may, however, be avoided, by means of a bath of sand. In all well regulated laboratories, this forms a standing part of the fixtures, though as far as I have observed, it is less used, and its convenience seems to be less understood in this country than in Europe. A very good extemporaneous one, suitable for the purpose here described, may be formed out of a common frying pan, filled with coarse sand, that is free from dust.

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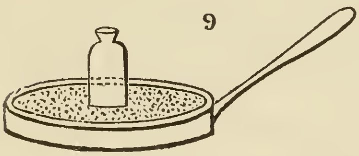

An apothecaries' phial, the bottom of which is thin, may have the sulphuric acid poured into it; it is then to be placed in the sand, so as to be half an inch from the bottom of the pan, and the sand piled round it, not, however so high as to be above the level of the fluid, for fracture will then be liable to occur; thus arranged, the pan may be placed on a clear fire, and the operation satisfactorily performed. Several liquids, as sulphuric acid and alcohol, boil with a kind of explosion, and not in the quiet tranquil manner that water does. A few shivers of glass, or pieces of platina foil, prevent this irregularity. By means of a sand bath, all temperatures may be commanded, from low redness, downwards.

21. Water baths, and steam baths, are also occasionally very serviceable, and very easily constructed, by means of utensils employed in domestic economy; a common tin saucepan, is a convenient vessel for this purpose. It should be filled with water to a suitable height, and the phials containing the material to be exposed, fixed in it so as not to be overturned by any violence in the ebullition; this may be effected by passing their necks through a piece of wood, long enough to fit tightly into the sauce pan.

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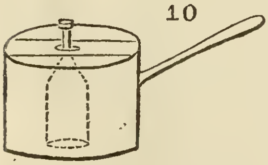

Franklin Institute.

Quarterly Meeting.

The fifty-first quarterly meeting of the Institute was held at their Hall, on Thursday evening, October 20th, 1836.

Thomas Fletcher, Vice President, presiding.

Charles B. Trego, Rec. Secretary, pro tem.

The minutes of the last quarterly meeting were read and approved.

Donations of Books were presented by Matthew Carey, Esq., R. C. Taylor, Esq., George Fox, Esq., Hon. James Harper, Isaac Hays, M. D., Robt. Hare, M. D., Prof. Alex. D. Bache, Messrs. Carey & Hart, D. Moulson, John Abbott, of Philadelphia; Timothy Claxton, Esq., of Boston, Mass.; Prof. B. F. Joslin, of Albany, New York; Prof. John R. Cotting, of Taunton, Mass.; the Society instituted in London for the encouragement of Arts, Manufactures and Commerce; Francis Baily, Esq. and Petty Vaughan, Esq. of London.

Donations to the Cabinet of Minerals, &c., were presented by Messrs. Felix Fossard, Rufus Tyler, and John L. Pearce, of Philadelphia; Calvin Mason, of York, Pa.; Timothy J. Dyre, of Fair Haven, Mass.

Prof. Franklin Bache presented a machine for dressing printers' types, formerly the property of Dr. Benjamin Franklin.

The Actuary laid on the tables the periodicals received in exchange for the Journal of the Institute, since the last meeting.

The Chairman of the Board of Managers presented the fifty-first quarterly report of the Board to the Institute, which was read and accepted; on motion, it was referred for publication.

The Treasurer presented his report of the finances of the Institute, for the quarter ending September 30, 1836, which was read and accepted.

Extract from the minutes.

Thomas Fletcher, *Vice President.*

Charles B. Trego, *Rec. Sec.*, *P. T.*

Fifty first Quarterly Report of the Board of Managers of the Franklin Institute.

The transactions of the past quarter of the year, furnish but little new matter to be communicated to the Institute, as it has been marked only by the prosecution of the general scientific inquiries in progress at the last meeting, and in making preparation for the active duties of the approaching season. The second part of the Report of the Committee on the explosions of Steam Boilers, has been completed and published, and contains an elaborate scientific explanation of the causes of such disasters, and manifold directions and cautions by which they may in a great measure be avoided. A bill has also been prepared to be submitted to Congress at their next session, to enforce the use of the protective measures which the Committee have deemed important, to give perfect security in the use of so valuable an agent as steam. It is hoped that the return of the gentleman to whom the results of the experiments on the strength of the materials employed in steam machinery were confided, for the purpose of making a report thereon, will very shortly enable him to complete it, and when that shall be accomplished, the people of the United States will be put in possession of information on the interesting subject, embraced in the investigation, of

incalculable value to their commerce and manufactures. The Report on the subject of Water Power is still in hand, and will be published as soon as the complex nature of the calculations will permit.

The committee of the Institute appointed under a resolution of the General Assembly of the State of Pennsylvania, for the purpose of making the necessary scientific observations, to fix the standards of Weights and Measures for the Commonwealth, have been requested by the Governor to superintend the construction of the standards themselves; little has yet been done on the subject, but the zeal which has sustained our committee in the arduous experiments on water and steam, will not fail to secure for our own State a system of vast importance in the distribution of the heavy metals and minerals, which now form so large a portion of her trade. Passing from subjects of a more general nature, to those in which the members of the Institute are more interested, we have great pleasure in stating, that our able and accomplished Professors, Mitchell and Johnson, will commence their lectures on the first Monday of November next, and that they have made preparations for courses of more than common interest. The Committee on Instruction have also secured the services of Mr. Booth, whose interesting lectures on Technology were so much esteemed last winter, and he will give, on Friday evening of each week, a course of instruction on Chemistry, applied to the Arts, embracing the processes employed in the preparation of many articles of importance in domestic economy, which cannot fail to be highly valuable and instructive to the class. Our Drawing School will continue under the care of Messrs. Mason and M'Clure, and will open in a few days. Of its success under their management we have no fears, and with the full conviction that it is only necessary to announce the opening of the School, we leave it to the patronage of the members and the public. The Committee on Instruction feeling a deep interest in the success of the Evening English School, established about four years ago, have thought that a reduction in the price of tuition would obtain for it a more liberal patronage, and have accordingly proposed to the very estimable gentleman who has conducted it, to charge three dollars per quarter, instead of five dollars, requiring the pupils to furnish their own lights and stationary. His answer has not yet been received, but should it be favourable to the change, the Committee will make an early public announcement of the fact; if, however, he should decline undertaking it on the terms proposed by the committee, it will not be advisable to open it with the scanty number of pupils who have hitherto attended. To the Cabinets of Models and Minerals, and the Library, several additions have been made, and the Board would here notice the very liberal donations of money which have been placed at their disposal, by the members, for the purpose of being invested in Books and Apparatus, by our much esteemed member, Professor A. D. Bache, now on a mission to Europe. The Committee on Science and the Arts, are still actively engaged in the examination of the numerous machines which the fertile ingenuity of our countrymen is daily bringing forth, and is realizing all the advantages promised by its establishment in bringing the theoretical and practical mechanics of the Institute together, on a field where they can be mutually benefitted.

Owing to the unusual demand for money which has been experienced for some time past in this city, the Committee on the New Hall have not yet been able to negociate such a portion of the loan authorized by the Institute, as would warrant them in commencing the erection of a more commodious edifice for the purposes of the Institution, and though our means

of extending still further the usefulness of the Institution will be somewhat cramped by the necessity of providing the funds requisite to meet the interest accruing on the debt to the Grand Lodge, for the purchase money, yet the Board feel assured, that an institution so intimately connected with the Mechanic Arts, will not be suffered long to labour under a disadvantage entirely pecuniary.

The same zeal which has given it upwards of 2000 members, and hitherto sustained it under more trying circumstances, will still continue to animate its members, and in a few years more, endeared to the public as well by its important services in the cause of education, as by its invaluable investigations of the most important practical and scientific objects, the name of the Franklin Institute will convey a highly exalted idea of national greatness, and stimulate our sister institutions to a greater zeal in the promotion of the Arts and Sciences.

M. W. Baldwin, *Chairman.*

William Hamilton, *Actuary.*

The Second Monthly Conversation Meeting of the season was held at the Hall of the Institute, on the 27th of October, 1836.

The attendance was very full, and the meeting one of much interest: upon the table were some excellent specimens of wood engravings, executed by Mr. Reuben S. Gilbert; and a new working model of a compound screw press, for packing cotton, &c., invented by Mr. Joel Barns.

Messrs. Wallace, Chandler & Co., presented a beautiful specimen of iron casting, in imitation of the celebrated Berlin castings, from the foundry of Messrs. Crocker & Richmond, Taunton, Mass.

Messrs. Greenough & Farnum submitted for inspection, several pieces of white flannels, of superior quality, and said not to shrink in washing; manufactured by the Ballard Vale Company, Andover, Mass.

Mr. Philos Tyler exhibited a wheel tire, the inner surface of which was deeply indented by the grain of the wood composing the wheel: this phenomenon elicited from several of the members some curious and valuable information relative to the effect of great pressure upon metals and other hard bodies.

Toward the close of the evening, Mr. James P. Espy communicated a brief, but very interesting, explanation of some meteoric phenomena, of frequent occurrence.

Mechanics' Register.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MARCH, 1836.

With Remarks and Exemplifications by the Editor.

(CONTINUED FROM PAGE 329.)

61. For making *Vegetable extracts;* Thomas Close and John C. Sandford, Rye, West Chester county, New York, March 18.

"The process consists in forcing through the cut, bruised, or powdered, particles of vegetable substances, a volume of steam, water, or other liquid, under and by a pressure, varying in intensity, according to the nature of the substances to be acted upon."

This patent is not taken for any particular form of apparatus; but a description is given of one which is considered and claimed as new. The pressure is to be continued for a longer or shorter period, according to the nature of the substance to be acted upon, and it is said that "the colouring matter, tannin, and other soluble parts of the wood or vegetable substance will be immediately and perfectly extracted, and with the use of a much less quantity of water, and in much less time than would be required by the ordinary process of boiling, infusion, or steeping, leaching, &c."

The patentees claim to be "the original discoverers and inventors of the art of extracting the soluble parts of vegetable substances, by means of the heavy pressure of steam, water, or other fluids, exerted upon and through the materials to be acted upon, however the pressure may be effected. Also the combination of the chamber and perforated lid as described; the combination of the boiler, water pipe, and steam pipe, with said chamber, and its said apparatus for the purposes aforesaid."

The whole process is well described, and we are not aware of any theoretical, or practical, objection to it; but, on the contrary, it appears to us that for many purposes it may be used with great advantage.

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62. For a *Portable Cooking Stove;* Charles Vale, Newark, Essex county, New Jersey, March 18.

This stove, it appears, is intended to cook by means of anthracite, or charcoal, as fuel; but we are unable, from the description and drawing, to form any clear idea of its construction and use. There are letters of reference used, and figures referred to, in the description, which are not to be found in the drawing; we therefore must dismiss the affair.

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63. For an improvement in the *Art of Tanning;* Henry C. Locher, Lancaster, Pennsylvania, Administrator of Henry Locher, deceased. March 18. (See specification.)

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64. For an improvement in the process of *Manufacturing White Lead;* Horner Holland, Westfield. Hampden county, Massachusetts, March 18. (The specification will hereafter appear.)

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65. For a *Hemp Brake;* John Pursell, Perryville, Mercer county, Kentucky. March 18.

The Break is made in the ordinary form, the patented improvement consisting in working the vibrating swords by means of a treadle, in the downward stroke, and in raising them by means of springs.

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66. For apparatus for *Worming and serving ropes;* Adam Montgomery, city of New York, March 18.

By means of this apparatus, four strans of rope yarn are to be served at once. The yarn is wound upon a kind of bobbin or tube, with heads, through the centre of which the rope passes, and the heads of which are large, to enable them to contain a sufficient quantity of yarn. The tube of the bobbin projects beyond the heads, and on one end a weight is suspended to give a proper tension to the yarn; against the other, the worming, or serving, mallet works, and is turned by hand in the usual way. There is a tube on the end of the handle, and at right angles to it, through which the yarns are conducted in their passage to the rope, whence they pass

through holes in a piece of metal projecting from the head of the mallet, and guiding them into their places on the rope. When used for worming, the hollow of the mallet is to be faced with metal, forming a segment of a female screw. When used for serving, the mallet has a plane groove, as usual. The claim is to "the before described apparatus for worming and serving ropes, and the manner of operating the same."

In the 29th volume of the 2nd series of the Repertory of Arts, there is a description of a machine very similar to the foregoing, but nothing is said about winding several strands at once. This, as an improvement, would have been a proper subject for a patent.

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67. For *Manufacturing Salt from salt water;* Richard K. Cralle, Lynchburg, Campbell county, Virginia, March 18.

A very full description of the apparatus employed is given in the specification, after which the patentee says, "What I claim as my own invention, not heretofore known or used, in the above described machine, is the application of the principle of evaporation *in vacuo*, to the manufacture of coarse and common salt. I claim to have invented the means of applying a known principle in physics, to the new and useful purpose of salt making. The machine described, so far as its construction is peculiar to the purpose above, I claim as my own invention. The machine may be varied in construction, and the principle applied in other modes; but I claim to be the original inventor of the means of applying the principle of evaporation *in vacuo*, to the manufacture of coarse and common salt."

The apparatus, as shown in the drawings, is intended merely to exemplify the principle, and not to furnish a definite arrangement; the description of it is elaborate and clear, but we find nothing to designate in what "its construction is peculiar to the purpose;" and therefore cannot tell what is claimed; this ought to have been distinctly set forth, as, in our opinion, it would form the only foundation for a valid claim. It has been decided that the application of a known machine to a new purpose is not patentable. To apply the same mode to the evaporation of water from a solution of salt, which has been applied so extensively to its evaporation from a solution of sugar, cannot fairly be called an invention, however useful it may be. If geese had never been roasted, although turkies had been usually cooked in that way, a patent for roasting geese would hardly be sustainable.

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68. For a *Metallic Mill;* Joseph C. Gentry, Dayton, Montgomery county, Ohio, March 18.

A cast-iron cylinder is to be banded, or otherwise covered, with cast-steel, then turned smooth, and picked with a pointed, steel tool. A concave of cast-iron, forming nearly a half circle, is to be adapted to the cylinder; and ribs, or bands, of cast-steel, projecting about one-sixteenth of an inch from its surface, are to be inserted in dovetail grooves, extending the whole length of the concave; these also are to be filed on their surfaces. The concave must be sufficiently open at one edge for feeding, and the cylinder is to be held down by springs, to prevent injury from the introduction of hard substances.

"What I claim is the steel or other metallic ribs, and the manner of fix-

ng them in the concave. And the cast-steel or other suitable metal, plated or banded on the cast cylinder. The manner of relieving the action of the cylinder by springs back of the boxes, on which the journals rest. The manner of picking the cylinder and ribs, presenting the sharp edges to each other, as described above."

Such a mill would be costly, easily put out of order, and difficult to repair. We are very apprehensive, also, that, when in the best order, it would not make very good flour. The claims embrace too many individual parts of the mill, some of which would not be able to stand alone.

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69. For a *Mortising machine;* George Page, Keene, Cheshire county, New Hampshire, March 18.

The general resemblance in principle between this and some mortising machines which have preceded it, is such as to leave little apparent room for a claim, and it does not occupy a large space, being to "the mode of attaching the slide to the upper lever and that lever to the machine; and also the lower box, and circular brace as described." We shall not take time to describe these particulars, but have no doubt that they are equally good with other modes of attaining the same end, and that the machine, if well made, will work well.

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70. For a machine for *Cleaning and Dressing Feathers;* Elam Wilbur, Geneva, Ontario county, New York, March 18.

Feather dressing machines bid fair to become as numerous as churns and washing machines, whilst, so far, they differ as little from each other as do a number of the former instruments. The claim in the present case is to "the steam chamber for generating steam in a separate chamber, or chest, from the case in which the feathers are placed; and the wings for blowing out the feathers at the door at which the opening in the ticking is placed to receive them."

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71. For a *Door Lock;* James M'Clory, City of New York, March 18.

The claim made is, to "the guards, the plates of tin placed between them; the levers and bar; the application of a double bitted key to this lock, and the mode of operating the several parts."

The drawing gives a very imperfect representation of this lock, and the claims extend to things which have no novelty when taken individually, as is done in the foregoing summary. The guard, are flat plates of metal laying upon each other, and operated upon by the key; the cam, or bit, of which is in steps, so as to push the plates to different distances, in disengaging the bolt. Double bitted keys have been frequently used; the mode of operation in some of the parts is new, but this is not the case generally. The lock is probably a very good one, and we believe that it has sufficient novelty to admit of a sustainable claim.

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72. For a method of *Making Pitch;* Henry Ruggles, city of New York, March 19.

The refuse, or tar, such as is left in making gas in the New York gas works, is to be boiled down to the consistence of pitch, and then put into barrels.

"I claim the exclusive privilege of boiling down, either in an open or

close vessel, kettle or still, the liquid such as is produced at the New York gas house, in the manufacture of gas, and known there by the name of refuse, until it becomes of the thickness, or consistency, of pitch."

The distilling of the spirit from the refuse, or tar, of gas works, so as to reduce it to the consistency of pitch, is a common and well known process in London, and in other places where there are large gas works; the *exclusive* right, therefore, is not likely to be conceded.

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73. For *Backs of stoves and fire places;* William R. Prescott, Hallowell, Kennebec county, Maine, March 19.

A tube of suitable diameter, say nine inches, and two or three feet long, is to be built in the back of a fire place, or fixed, in any convenient way, in a stove; a tube, of about two inches diameter, is to lead from without the room, into this longer tube, to supply it with cold air, and warm air tubes are to lead from either end of it, into the room, to afford a supply of warm air.

The claim is "to bringing, in the manner described, the cold air from without the room to which the fire place is situated and supplying it to the stove, and of thus keeping up a circulation of cold air from without, and of warm air into the room. The application of the apparatus described for fire places, stoves, and fire frames, for the purpose of warming rooms, and its general construction."

Whilst there is nothing new in this principle, the form pointed out for carrying it into effect would be one of the least efficient; the "general construction" is so general, and so extensively employed, that it is a little remarkable it should be claimed as new.

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74. For a *Furnace for generating steam*, on board of steamboats, and for other purposes; Eliphalet Nott, Schenectady, New York, March 19.

The improvement consists in giving a coating of silicious matter to the insides of furnaces for burning anthracite, so as to prevent that fusion which takes place when the lining is argillaceous, and also in covering the grate bars, or bottom of the furnace, with fragments of such stones as are suitable for the purpose, to protect the bars from the action of the fire. Each of these applications is claimed for the use of furnaces for steamboats. There is no adequate information given respecting the first application; we are merely told that the coating is to be performed "with some other material, (as silex) that will not flux by the mere action of the fuel in use; the same to be put on in the form of grout, as similar coatings are put on to melting furnaces, to prevent the action of the contents on the crust thereof." Now silex cannot be so put on, it not having the slightest adhesive property; and if mixed with clay, the two make a fusible compound. Nothing, we apprehend, is secured by this part of the patent, as there is not any thing practically explained.

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75. For an improvement in combined *Pen and pencil cases;* Henry Withers, an alien, who has resided two years in the United States; city of New York, March 19.

For this pen and pencil case, the two instruments are to be used at the same end, either of them being protruded at pleasure. The pencil holder. with its ordinary adjustments, slides through the tubular pen holder,

and the claim is made to "a pencil holder of any known or convenient structure, made so as to pass through, or by the pen holder, in his said combination."

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76. For a *Forge anvil block;* Samuel Van Tiers, M'Connelsburg Bedford county, Pennsylvania, March 19.

"The crib, sills, cellar or spring planks, and bed timbers, are made and arranged in the usual manner. Instead of the usual mode of having a wooden block upon which the anvil is placed, secured by the braces, props and wedges, my improvement consists in casting the anvil block of cast-iron, in a pyramidal figure, with a cavity to receive the anvil; it has flanches through which are apertures to admit strong screw bolts, by which to secure the anvil block to the bed timbers and spring boards. The bolts are passed through apertures in the spring boards, bed timbers, and the flanch of the anvil block, and secured by rivets resting upon the upper surface of the flanch, the other end of each bolt having a broad head bearing against the under sides of the spring boards."

"What I claim as my invention, and for which I ask a patent, is the cast-iron anvil block, and mode of securing the same, as before described."

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77. For a mode of *Conveying rafts, boats, &c., over dams and shoals;* Stephen Underwood, Bath, Grafton county, New Hampshire, March 19.

Two inclined, plane rail-ways are to be erected, one on each side of the dam, or other obstruction, over which a boat, &c., is to be carried; these are to extend into the stream, so that the load can be floated on to a car, constructed to run upon the planes. The planes are to terminate, at their upper ends, at the distance of from thirty to sixty feet from each other, or equal to that of the car upon which the boat or raft is to be carried. This space is occupied by a vibrating rail-way or bridge, which tilts on a centre, and will form a continuous plane with either of the sections accordingly as it is tilted towards the one or the other. A windlass, turned by water, or other power, receives a rope, or chain, by which the car can be raised, or lowered, upon the planes. When a load is to ascend, the bridge is tilted towards the plane up which it is to be drawn, and it is hauled upon it; the bridge is then tilted towards the descending plane, and the load is lowered into the water.

There is a contrivance on the car, by an arrangement of eccentric rollers, by which the level of the load can be changed, so that it shall stand horizontally in ascending and descending.

The claim is confined exclusively "to that part of the apparatus employed, which is denominated the *vibrating rail-way*, which is intended to receive the load at the summit of the inclined plane, and to be adapted by its vibrating motion to the plane of either, for the purpose, and in the manner set forth."

This plan has been carried into successful operation; large rafts of timber being conveyed, by its means, down rivers where the passage was previously attended with extreme difficulty, and where it could not, sometimes, be effected.

78. For an improvement in the process of *Tanning hides and skins;* Laban Emery, city of New York, March 19.

The patentee directs the hides, or skins, to be prepared for tanning in the usual manner, and adds, that "my improvement or invention then consists in the application to the bark liquor, of nitre, or alum, or epsom, or Rochelle, salts, or other neutral salts, either separately, or together, mixed in with the liquor, in the proportion of about four pounds to four dozen skins, more or less; and also bearing some proportion to the strength of the liquor. Every time the bark liquor is renewed, a like quantity of such neutral salt may be added, or not, as may be thought proper, or as the process of tanning may be required to be hastened. Either of said articles may be used separately, or together, in the process of tanning morocco, as well as every other description of tanning."

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79. For *Preserving milk for use on voyages, &c.;* John Lewis Granger, city of New York, March 19.

Fresh milk is to be put into bottles, and these are to be closed, in the manner of corking, with some porous substance, which will allow air to pass through it; the bottles are then to be put into a vessel of cold water, and the whole gradually heated to the boiling point, after which the porous stopper is to be covered with wax.

The claim is "to the evolving of gas, and suffering it to escape from the milk, and immediately afterwards excluding the atmospheric air from commingling therewith, by the method substantially as described."

We apprehend that the theory above intimated, namely, that the gas contained in milk is the cause of its spontaneous decomposition, is not founded in fact; were this the case, an exhausted receiver would as effectually effect the object in view, as the boiling heat, and this process would not be "substantially as described." There is a chemical change produced in milk by boiling, by which its liability to further reaction is very much diminished, and which would not be produced by the mere expulsion of gas. This theoretical point, we are aware, has nothing to do with the validity of the claim, although we have thought proper to give it a passing notice; we have also something to say about the novelty of the process. In the celebrated report published by the French Government in 1810, on Mr. Appert's mode of preserving all kinds of animal and vegetable substances, milk is mentioned as having been preserved by boiling and corking closely; it was concentrated in the boiling by allowing a portion of its watery particles to evaporate; the process was, we think, substantially the same with the above, the principle of which was perfectly well known.

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80. For a *Cider Mill;* Christian Sheaffer, Lebanon, Lebanon county, Pennsylvania, March 19.

This cider mill is to grind the apples by means of revolving nuts or, toothed cylinders, of which there are three, mashing into each other. All the novelty appears to be in the manner of building the mill. We are told that "the machine consists of two pair of stairs, a frame, an apple mill made of three cog wheels; cage or receiver, a press beam, two main screws, one assistant screw; two weight boxes, &c. &c." After describing the two pair of stairs, and the other component parts of the machine, it is said, "I claim as my invention the whole of the machinery, excepting what I have named the cage or receiver; the bed or box belonging to the cage or receiver, and

the manner of mixing the straw with the ground apples, or rather the *smashed* apples." This claim to the whole machinery, cannot be understood to mean the machinery as a whole, but as applying to its component parts individually; scarcely one individual of which could bear the burden thus put upon it, without being *smashed.*

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81. For a *Cooking stove grate*, and its appendages; Orrin Wilson, Concord, Middlesex county, Massachusetts, March 23.

The grate to contain the coal, or wood, is made with bars, and, in general, like the ordinary grate of an open fire place; but it is so affixed to a cooking stove, with ovens, or other desired appendages, as that it may be raised vertically, so as to communicate its heat more directly to the cooking department, or lowered so as to form an open stove. Above the grate, a windlass crosses, near the front of the stove, and four chains attached to this windlass, and to the four corners of the grate, serve to raise and lower the latter, as may be desired.

The claim is to "the movable grate, or pan, whether operated with chains and pulleys, rack and pinion, or other mechanical powers; the peculiar adaptation, arrangement, and combination of the several parts of the stove, fire frame, or fire place, to the said movable grate, for the uses and purposes herein described and set forth."

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82. For a *Stove*, denominated the Sibelline Stove; Wm. M. Carmichael, Hempstead, Queens county, New York, March 23.

A cylindrical stove, lined with fire clay, is made in the usual manner. The stove is to be surrounded by a second cylinder, leaving an air chamber between the two, with apertures below to admit cold, and others above to discharge warm, air. The whole stove is to stand upon a drum, or pedestal, of a diameter considerably larger than the stove itself, and is to be surmounted by another drum, or hollow dome, elevated a few inches above its top; a smoke pipe from the centre of the top of the stove, conducts the smoke into the drum. Four, or more, hollow columns, connect the two drums, surrounding, but detached from, the body of the stove; these columns form flues between the two drums, and from one of them a smoke pipe leads into a chimney, there being a damper in the column, above the smoke pipe. When this damper is open, the smoke and heated air pass directly through the upper part of the column, and into the exit pipe. When the damper is closed, the draught has then to pass down the three open columns into the lower drum, and up the fourth to the smoke pipe.

"The arrangement and adaptation of the several parts of the stove, producing the one before described," constitute the whole claim, which is about tantamount to not claiming any thing. The resemblance between this and the stove patented by Mr. Attwater, at p. 54, vol. xvii. is not very remote; and this latter, as is there described, we view as but a modification of Spoor's stove.

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83. For a *machine for manufacturing shoe pegs;* Reuben H. Thompson, Rochester, New York, March 23.

"The principal points upon which the inventor depends, is the *cutting* of pegs, instead of *splitting*, and the making them from a long cylinder of

wood, in a continuous course to the centre, and completing the peg from a solid block, wholly by machine power."

We cannot describe this machine without drawings of its parts. It is clearly enough described and represented, but the foregoing claim refers merely to the thing done, and not at all to the means by which it is effected; it has no bearing, in fact, upon the machine that is the subject of the patent, and which is, certainly, sufficiently original to have been directly claimed.

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84. For a *Cot Bedstead and Camp Stool;* Samuel Clark, city of New York, March 23.

The pin which connects the cross legs of this cot bedstead, or stool, is a toothed pinion, the teeth of which take into racks formed in a slot, or mortise, in either leg, and acting in such way as to stretch the sacking, by the weight placed upon it. A stretcher also extends across from one leg to the other, and the head board is so connected to the side pieces, as to allow them to recede unobstructed. The claim is to "the application of the stretching bar, and the movable rack and pinion joint, to the cot bedstead, and articles of a similar construction." The device is simple, but ingenious, and appears likely to answer a good purpose.

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85. For a machine for *Working off the ends of casks, and smoothing them;* Sumner King, Suffield, Hartford county, Connecticut, March 23.

A vertical, revolving shaft is to carry a grapple, or a kind of spring chuck, which is to receive and hold the cask that is to be worked off by a leveller, a stock howell, a croes, and a plane. The claim is to "the revolving grapple tub, that secures the cask."

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86. For an improvement in the art of *Dissolving Caoutchouc, or India Rubber;* Patrick Mackie, city of New York, March 23.

"What I claim as new, and of my invention, is the use of oil of tar, or spirits of tar alone, and also the use of oil and spirits of tar mixed with the prepared sulphate of zinc, as a solvent for dissolving india rubber, for the purposes aforesaid."

We could turn to patents for the use of the same liquid, in the employment of which, therefore, there is not any thing new. The spirit from coal tar has been extensively used in England, and is well known here, but its odour is extremely offensive. The spirit from common tar is principally oil of turpentine, with empyreumatic matter, which does not improve it.

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87. For a *Washing machine;* Ezekiel Y. Watson, Albany, New York, March 23.

An oblong box, furnished, in its bottom, with a curved row of rollers, upon which the clothes are to be rubbed by a frame of rollers passing over them, constitute the machine; and "the before described machine for washing clothes," forms the claim.

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88. For a *Cannon vent;* John W. Cochran, Lowell, Massachusetts, March 23.

The thing here proposed is to place the vent of a cannon, by which the

powder is ignited, considerably forward of its usual position, so that the fire may be communicated near the centre of the charge.

"In the position of vents now actually adopted, the charge is ignited at the bottom, and much of the powder is often thrown out of a cannon without being fired at all. This applicant contemplates the application of the principle of his improvement by placing the vent as far forward of the bottom of the breech, as the outer part of the powder may extend, and to put two or more vents in similar positions."

The idea of placing the vent as proposed, is without novelty, and has been frequently discussed by engineers. The following extract from Lallemand's Artillery, N. York. 1820, p. 18, is given in proof. "It is agreed upon all sides, that the vent of a piece of artillery would be most advantageously placed if it communicated the fire to the centre of the charge; for, in this case, the inflammation of the powder, which is not instantaneous but successive, takes place soonest. However, it is usually made to enter the bottom of the charge, to avoid too violent a recoil, that would derange the fire, and injure the gun carriages; particularly those of larger caliber."

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89. For a *many chambered cannon;* John W. Cochran, Lowell, Massachusetts. First patented October 22d, 1834. Surrendered and re-issued upon an amended specification, March 23.

We noticed this invention at p. 326, vol. xv., and expressed an opinion that the use of a gun constructed like that described, would be attended with extreme danger. Since that period, however, the thing has been tried to some extent, both in this country, and at Constantinople, and as it appears, from all the information which we have gleaned upon the subject, without the realization of any of those difficulties which we apprehended. We are well convinced, in fact, upon more mature reflection, that some of the objections to it which we then deemed the most formidable, were not well founded; but we have not time, nor is it necessary, to discuss this subject here; it would afford us sincere pleasure, had we more frequent occasion to withdraw our objections to patented inventions.

The claim now made appears to us unnecessarily verbose; it amounts, however, simply, to the combination of a cylinder with a section of a cannon, the cylinder perforated on its periphery to receive the charges, and made to revolve by suitable devices, so as to effect the proposed object substantially in the manner described.

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90. For a machine for *mortising and tenoning;* Erastus M. Shaw, Wilbraham, Hampden county, Massachusetts, March 23.

This machine differs in its general construction from most of the mortising machines which we have previously noticed, and by more labour than we can bestow upon it, we think that we might find out the manner of constructing it; but the drawing is very indifferently executed, and to decypher it is a task we shall not undertake. The claim is to "the arrangement and adaptation of the several parts of the machine, producing the one here described for mortising and tenoning timber; particularly the manner of operating the machine, in causing the carriage to move to the right and left, whilst the slide, with the cutter, moves horizontally backward and forward, at right angles to the carriage."

91. For *Condensing cotton roping, or slubbing;* William Fowler, Fishkill, New York, March 23.

"The principle of this improvement consists in the compressing of the sliver by means of a revolving groove, into which it is pressed by a revolving periphery pressing into and revolving with said groove, the said revolving groove and periphery constructed substantially, as aforesaid, and combined with a spool constructed and moving so as to take up this sliver when thus condensed, or compressed into roping spirally, as described."

To the idea of this invention given in the foregoing summary; we add that it consists of revolving wheels of about seven inches in diameter, and about three-eighths wide, having a groove, on its periphery, about one-tenth of an inch wide, and the same depth; four small, condensing wheels, each about one inch and a half in diameter, have tongues or fillets, which run in the grooves, and condense the roping, thereby producing the necessary firmness without the twist and counter twist, usually given by the condensing apparatus.

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92. For a *Straw Cutter;* James Hyde, Darien, Gennessee county, New York, March 23.

There not being any claim made to any part of this apparatus, we know not what the patentee considers as new about it, and therefore pass it by.

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93. For a *Thrashing machine;* Hugh and Israel W. Edgar, Wayne county, Ohio, March 23.

This is a cylinder and concave machine, set with spikes, much in the usual way; the patentees claim the form in which they construct the frame, and the manner in which they fasten the spikes by screw nuts, rendering the whole strong and durable.

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94. For a *Rotary Steam Engine;* David Ulam, Greensburg, Westmoreland county, Pennsylvania, March 23.

A hollow drum, furnished with an opening to admit, and another for the discharge of, steam, is to have a wheel or drum, revolving in it, of such size as to leave a steam chamber between them. A projecting piece on the inner drum fills this cavity, and is made to recede, by suitable means, when it must pass the stops against which the steam is to react. The whole thing is nothing but an oft-told story, without a single new incident to redeem its monotony; but old as it is, and worthless as it will prove to be, the patentee says, "what I claim as my invention, and which I desire to secure by letters patent, consists in the before described rotary steam engine."

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95. For a *Stone Auger, for boring rocks;* Andrew Turney, Reading, Fairfield county, Connecticut, March 30.

The main point upon which the claim under this patent rests, is the forming of the point of a stone drill, with a sort of knuckle joint, so that when inserted into a hole which has been drilled cylindrically by a common drill, the joint will bend on one side, and enlarge the hole at the bottom, that a larger charge of powder may be introduced, and its force increased. There is also a claim to the working of the auger with a spring, and to the kind of scraper used to remove the drillings. We doubt altogether the utility of the invention, as the apparatus is constructed, but cannot form a fair judgment from the evidence before us.

96. For an improvement in *Bee Hives;* Sturgess M. Judd, Danbury, Fairfield county, Connecticut, March 30.

The hive said to be improved, is that patented by Levi H. Parish, on the 5th of August, 1834. The claim made "in the suspension of said boxes, and in their movement, and in their movement in grooves, by which the bees are prevented from escaping during the removal of the boxes, as combined in the manner specified; and also the knives for separating the combs between the boxes and the slats." The peculiarities of these parts we leave to be examined by those interested in them.

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97. For an improvement in a *Suction and Forcing Pump, for fire engines;* John F. Rogers, Waterford, Saratoga county, New York, March 30.

A patent was obtained by the same gentleman, on the 27th of February, 1833, for a pump upon the same general construction with that which forms the subject of the present patent. We gave a pretty full description of the former, in vol. xii. p. 103. The claim under the present patent, will, with the aid of the reference just made, afford a tolerable idea of the nature and object of the proposed improvement, which, it will be seen, is to remove one of the objections made by us to the former construction.

"What I claim are the openings through the shaft by which the water is passed through the pump more direct than can be done in any other way, thereby removing the obstruction of the water caused by changing its direction."

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98. For an improvement in the *Power Loom;* Francis C. Lewis, Grafton, Worcester county, Massachusetts, March 30.

The claim under this patent refers to the drawings, and without these, therefore, could not be understood. The following quotation will furnish the object of the improvement, but not the means by which it is attained.

"The great practical advantage of my improvement is, that the weft is driven up by the reed, while the cloth roller is stationary, and there is no power operating upon it, so that the thread of the weft, and the cloth, receive the full blow of the latter; whereas, by the looms formerly in use, the cloth recedes, and is taken up as the latter strikes."

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99. For a *Horse Mill for grinding grain and scouring seeds;* John Harman, Jr., Brownsburg, Bucks county, Pennsylvania, March 30.

The grinding machine consists of two grooved, iron, cylinders, of different sizes, and running with different velocities; one of them having a narrow, fluted, iron concave to aid in the grinding. A horse power, by which the mill is to be driven, is also described, but there is not any representation of it in the drawing; both machines, however, are claimed; the claim being to "the combination and arrangement of the several parts of the horse power in connexion with the grinding machine, as set forth."

However good the inventions might be, the foregoing claims would invalidate them. The whole grinding machine is claimed, yet it possesses but little novelty; the horse power is claimed, yet there is no representation of it, as required by law. And what would of itself be fatal, two distinct machines are included in one patent.

100. For applying *Rivets to harness and gears;* William Dukeheart, city of Baltimore, March 30.

The claim made is the using rivets of metal, in the making of harness, instead of sewing, or stitching, as formerly practised.

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101. For a *Tide Water Wheel;* Carey S. Mercer, Franklin, Baltimore county, Maryland, March 30.

A horizontal wheel is to be placed in a case, or drum, having flooms at opposite sides thereof, to direct the water upon the buckets, either on the ebb or flow of the tide; guide pieces, or wings, are fixed within the flooms to direct the water upon the buckets; and the claim made is to "the curved guider as described." The contrivance is not worth many words, and we could not talk it into utility.

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102. For an improvement in the mode of *Spinning Wool;* John Wethered, Baltimore county, Maryland, March 30.

"What I claim as new in the machine herein described, and for which I ask an exclusive privilege, is the combination of a tube and other means, of giving a rotary motion to the sliver, with two or more sets of rollers of different speeding, a tube between each set, whereby a twist is given to the sliver, roll, roping, or slubbing, while it is passing from one set of rollers to the other, so enabling it to bear the elongation produced by the different speeding of the sets of rollers, in order to make it of the proper size for spinning: and I should consider any contrivance by which the strength of the sliver was increased by twisting between the sets of rollers, as an encroachment upon my invention."

The foregoing will suffice to inform those used to spinning machinery, of the nature of this invention; the object of which differs, as the patentee observes, from that of the revolving tube previously in use for condensing the sliver as it leaves the carding machine, to fit it for winding on the spools. The invention appears to be well adapted to the accomplishment of the end proposed.

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103. For an improvement in the *Cotton Planter;* Michael Beam, Buffalo, Lincoln county, North Carolina, March 30.

This patent is obtained for an improvement on a machine patented by the same person, Feb. 13th, 1835. The present contrivance consists, in part, of a barrel shaped reservoir, in which the seeds to be planted are put, and which revolves, as the frame upon which it is supported is drawn forward; it has adjustable openings, for letting out the seed, an apparatus for opening the furrow, and a harrow for harrowing the seed in. The points intended to be claimed consist of the peculiarities of form, structure, and arrangement, which are not very clearly described, and could not be understood without drawings.

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104. For a *Double Reflecting Lamp;* John C. Fletcher, Springfield township, Clark county, Ohio, March 30.

The lamp here described is of the hanging kind, the reservoir for the oil being formed like that of the astral lamps, so that the light can pass downwards without obstruction. There are to be reflectors above the light, polygonally formed, and sloping from the glass chimney upwards; the inside of the reservoir, also, is to be lined with similar reflectors, and around its

lower edges there is a trough for catching the drippings of oil. We are of opinion that these latter reflectors will produce but little advantage.

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105. For a *Hat Block;* Wm. W. and S. H. Jimeson, Wheeling, Ohio county, Virginia, March 30.

This block is to be in six pieces, four outside pieces, two of them formed by cutting opposite segments from top to bottom, off the opposite sides of the block, and the other two by cutting the middle segment across, so as to leave a square centre piece, somewhat pyramidal in form. There are to be tongues formed up each side of the centre piece, and corresponding grooves in the side pieces, extending to within an inch of the top, serving to prevent all lateral slipping. In steaming, the centre piece is to be plain. There is to be a Boss block, of the usual construction; and to the bottom of this a *circular pedestal* is to be attached, by a bolt passing through the centre of each. The claim is to "the before described block for finishing hats, especially the tongues and grooves, and the circular pedestal which permits the block to revolve freely whilst finishing hats."

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106. For forming *Joints for Bedsteads and other wood work;* Solomon C. Batchelor, and Nelson S. Thomas, Watertown, Jefferson county, New York, March 30.

The patentees claim, "being able to frame, by means of keys, right angled works, where the rails, or timbers are on the same level," and we have looked into the thing, with more than common care, to find something about it "not previously known;" but we have not been able to discover any thing which is not well known to every workman who has made mortises and tenons. The rails are to be tenoned into the posts in the usual way; one end of the tenon to be cut dove-tailing, and the mortise sloped to suit it; a wedge, or key, is to be inserted at the other end, and the work is done. In this simple and well known affair, it would be difficult to assign to each of the two patentees, the amount of his inventive contribution.

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107. For a *Vertical Wool Spinner;* William Sykes and George M. Conradt, Fredericktown, Frederick county, Maryland. First patented March 10th, 1834. Surrendered, and re-issued upon an amended specification, March 30.

The object in view in this patent, is the same with that of Mr. Wethered, No. 102, but the means of attaining it are different. The following is the claim, "What we claim as our invention, is the constructing of drawing rollers for spinning machinery, in such a manner as that they shall embrace the thread between them during a part of their revolution only; allowing it to twist freely, unobstructed by them during the remaining period; by which means we are enabled to carry the twist directly from the flyers up past the drawing rollers, without employing any intermediate machinery; using in conjunction with such drawing rollers, either live or dead spindles, and such other parts as are ordinarily employed in spinning machines, and to which we make no claim."

The proposed mode of relieving the thread from the action of the drawing rollers, is by cutting off a portion from one side of them.

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108. For an improved *Franklin, or Open Stove;* John H. B. Swansey, Lynn, Essex county, Massachusetts, March 30.

"The improvement made by me is the addition of two more flues, or drafts,

beside the common ones in the Franklin stove. One of said additional flues is to be made a little above the middle of the fire back, and to extend horizontally the whole length of the back, and is to be provided with a common damper, to open and close it. The other additional flue is to be placed along the front plate of the stove."

The drawing does not exhibit the thing very clearly; it does not, however, so far as we can judge, appear to be an affair of much importance.

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109. For *Compressing Hay, &c., and elevating heavy bodies;* Adrastus R. Chamberlin, and Artemas Cleflin, Richmond, Lincoln county, Maine, March 30.

A pinion and wheel are to turn a shaft, round which a chain is to wind, which chain passes over a pulley at the end of a piston rod, that is to carry the follower for pressing. The other end of the chain is to be fastened to some fixed body. Instead of passing over the pulley, on a follower, the chain may be attached to a stump which it is desired to draw from the ground.

The claim is to "the application of the pulley as used by us, for a single or double press; and the application of our machine to the raising of stumps or other heavy burdens." There are so many better machines, for effecting the same purposes, that this will stand but little chance of going into operation; or if it has been used, we apprehend that it will soon cease to be so.

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110. For an improvement in *Wind Mills;* Job Wilbur, Fall River, Bristol county, Massachusetts, March 30.

This is to be a horizontal wind mill, to contain the vanes, or wings, of which, a round building, thirty feet high, and twenty in diameter, is to be erected; the upper part of this building, is made to revolve on the lower, in order to change the situation of two windows, or openings, made for the admission and discharge of the wind. Six vanes, placed on a vertical shaft, in the centre of the building, are to receive the action of the wind; these vanes are to be angled to hold the wind the more effectually.

There is no claim made, a point, in the present case, of no great importance, the structure being very much like others which have been tried, and abandoned.

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111. For a *machine for manufacturing Axes;* Elisha K. Root, Canton, Hartford county, Connecticut, March 30.

We shall hereafter notice this machine, in conjunction with some others in use, at the axe manufactory in Collinsville, Connecticut, to which establishment we, a short time since, made a visit.

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112. For a *Forcing Pump;* Nathan Chapin, Penn-Yan, Yates county, New York, March 30.

We see no reason to attempt a description of this double barreled forcing pump, as we cannot discover any valuable point in it beyond such as are in ordinary use.

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113. For a *machine for ploughing and thinning cotton;* Harvey W. Pitts, Wilsonville, Shelby county, Alabama, March 31.

The claim made is to "the machine as described," a claim which it will hardly bear, as parts of it are very similar to machines which have been

used for like purposes; yet we believe there is sufficient novelty in the contrivance to enable it to sustain the character of a new machine. We shall not take time to describe it, as it would be no easy task to render it intelligible without a drawing.

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114. For a *Corn Sheller;* Albert W. Gray, Middletown, Rutland county, Vermont, March 31.

This machine is to operate upon the ears by means of a revolving, flat wheel of wood, set with points, and standing vertically; the ears are to be held up against it by means of a spring conductor. The general arrangements are very similar to those in other revolving, disk shelling machines, and the particular points and combinations which are made the subject of a claim, appear to be unimportant, not, we apprehend, rendering it either better or worse than others previously in use, and now public property.

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115. For *Wagon and Carriage Springs;* Newell Hungerford, Ithaca, Tompkins county, New York, March 31.

Spiral springs which are wound round an iron bar crossing the carriage, and attached to the bar at their inner ends, are, at their outer ends connected to the bottom of the body of the carriage, or wagon. The round bar, above named, is supported at the two ends by a bowed piece of iron, bolted to the axle through its middle. The specification ends abruptly, without pointing to any novelty, or making any claim. A single coil of spiral spring will not fulfil the intention of a carriage spring; it has been tried in various ways.

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116. For an *Awl Shaft;* David M. Smith, Gilsum, Cheshire county, New Hampshire, March 31.

The wooden part of this haft is in two pieces, the lower piece containing the socket, and fitting, and revolving, in the upper one by means of a round pin; the wood part of the socket is bored tapering, and has in it a split, metallic socket, into which the shank of the awl is inserted, when, by turning the two parts of the haft upon each other, a nut draws the split socket inwards, and holds the awl.

The claim is to the "constructing an awl haft, so as to move the split socket in and out, into which the shank of an awl blade is inserted, and by which it is held firmly, as above described."

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117. For an instrument for *Cutting the Soles of Boots and Shoes;* Jonathan Hill, Billerica, Middlesex county, Massachusetts, March 31.

A knife is to be made in the form of the sole to be cut, and this is to be pressed on to the leather by a press, or in any other convenient way. Two iron bars are described, which are to lie along the back, or upper side of the knife, from heel to point, but these are not an essential part of the contrivance. The affair is not new, such knives having been made, and patented, both for cutting uppers and soles. The claim is to "the construction of the knife, being entirely in one piece; and the application of the same to the purpose of cutting soles, by means of a lever, or lever press.

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118. For *Reflecting Ovens;* Cicero Van Allen, Penn Yan, Yates county, New York, March 31.

In the claim appended to the specification of this reflecting oven, we are

told about two new principles in it, yet we are at a loss to discover one; it is so much like some other tin kitchens, for baking and roasting before the fire, and our eye so little like that of the inventor, that we cannot see the new parts to which he believes that he directly points. The sides, back, and bottom appear to be rectangular, and the top to slope regularly back; there is a spit for fowls, hooks for birds, bars on which to place pans, a dripping pan to catch the gravy, and a peep hole through which to observe how matters go on, and these constitute the "single reflecting oven."

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119. For a *Self moving and accumulative engine;* John James Giraud, city of Baltimore, March 31.

How many self-moving and accumulative engines have the same parentage with that before us, we cannot recollect, and do not think it worth while to examine, in the patent office, the register of their births; as to their deaths, no register exists, they having all been still born; we know, however, that the family would have been a large one had they received and preserved the living principle. We can tell little about the affair before us, but its author informs us that "the fly wheels run on friction wheels, bearing on the main shaft, and constitute the generating, regulating and maintaining powers of the engine." The power thus generated, regulated, and maintained, is to be applied to "general navigation and other purposes." Happily for the community, however, neither general navigation or other purposes which demand motive power, will consent to wait the generating, regulating, or maintaining power of Mr. G.'s accumulative engine, as otherwise they would never be generated, regulated, or maintained.

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120. For a *Churn;* Thomas Nicholson, New Market, Shenandoah county, Virginia, March 31.

A churn, with a tub in the ordinary form, has a dasher shaft, which is to revolve alternately in reversed directions; for this purpose there are two beveled pinions upon the shaft above the lid; and a beveled segment wheel is to engage first with one, and then with the other of these pinions; such a contrivance is bad in principle, as all machinists know; segment wheels being generally poor things, and, as here applied, altogether worthless.

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121. For *Pronged Hoes;* Benjamin F. Boyden, Boston, Massachusetts, March 31.

These hoes are to be of cast-iron, rendered malleable in the usual way. They are to have raised ribs along the prongs, &c. to strengthen them, and to be tinned over their whole surface. The claim is to "the application of cast-iron in the manufacture of agricultural pronged hoes, and covering the same with tin;" but where is the invention or discovery?

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122. For an improved *Winnowing machine;* Jonathan Bean, Montville, Waldo county, Maine, March 31.

We are told that "the advantages this machine claims above others now in use, consist in durability, portableness, and expedition in cleaning all kinds of grain;" but although the machine claims this, the patentee does not claim the machine; and although he has given a voluminous account of admeasurement, and many outlines of separate parts of it, its construction

is very imperfectly represented, and its peculiarities, if any it have, are unnoticed; the patent, in fact, is a patent for nothing.

123. For *Hose to convey water;* Samuel Hunt, city of Baltimore, March 31.

"What I claim is the application of hose, whether constructed in the manner set forth, or otherwise; not intending to confine myself to particular dimensions or materials in its construction, for the purpose of carrying good and wholesome water, for the use of cities, towns, and villages, &c. across rivers, ponds, bays, creeks, or elsewhere."

There are two doubtful things in this patent; first, it is much to be doubted whether a man can be prevented from conveying water in a hose, through a creek, &c.; but a more important point is the doubtful utility of the thing, for the purpose intended. A flexible hose, large enough to convey a supply of water for the consumption of towns, it will be difficult to make, more difficult to fix, and most difficult to keep in order.

124. For a *Blacksmith's Tew Iron;* John Shugert, Elizabeth, Alleghany county, Pennsylvania, March 31.

"The improvement claimed by the petitioner, is the angles in the pipes and plates, by which it is made entirely fire proof, or indestructible."

How this desirable end is to be attained by the construction of the instrument described, we do not perceive. An iron back is to be made to the forge; the pipe which leads to the opening for the blast, is to be ten, or twelve inches in length; the hole through it about two inches in diameter, at the back end where the bellows enter, and gradually diminishing to one inch, next the fire. At about the middle, the pipe is bent down at an angle of from twenty to forty degrees towards the fire. Instead of the usual collar next the fire, there is to be a metal plate ten inches long, and nine broad, "about one inch from the centre of which there is to be an angle of about ninety degrees, the broad part of this angled plate is to have a rise on the face of it at the centre, one inch high, and ten inches along the plate; the thickness of the said plate to be about three-fourths of an inch."

The foregoing description does not appear to us very clear, but it may be more fortunate with our readers.

125. For *Blowing air into a millstone eye;* Austin Taylor, Littleton, Grafton county, New Hampshire, March 31.

"What the applicant claims as his invention, is the introducing a current of fresh air into the eye of a mill-stone, by any wind instrument or machine." Wind has already been blown into the eye of a mill-stone, to keep it cool, and has been made the subject of at least one patent.

126. For *Spark Catchers, for locomotive steam engines;* William Schultz, county of Philadelphia, Pennsylvania, March 31.

There is to be a swell in the smoke pipe, which will give to it the form of two funnels joined together at their rims; and across this wide junction there is to be wire gauze stretched, the enlargement being intended to prevent any obstruction in the draught. The pipe for waste steam is to perforate the sheet of wire gauze, which is secured to it by a flanch. Flues, which may be opened when the engine is at rest, are to pass on the outside

of the conical enlargements, allowing a free draught; these are to be closed by valves, when the engine is in motion.

Claim. "What I claim is the whole arrangement, as hereinbefore described, without any connection with any other machine heretofore constructed for the same purposes."

127. For a *Horse Power;* Richard Skinner, Williamson, Wayne county, New York, March 31.

A main wheel, turned by levers, or sweeps, is to run upon a hub, and axletree, instead of being fastened to a shaft. Nothing more.

128. For a *Cooking Stove;* Benjamin H. Pearson, Warner, Merrimack county, New Hampshire, March 31.

This stove has an open fire place, in the form of a Franklin; to which is attached an oven, and other contrivances for cooking. The claim is to "heating the oven on five parts; its particular situation to give a draft under the oven, with an open fire-place; the damper; the turning a crank with two half oval wheels to raise or lower the grate in the fire-place."

129. For a *Hydrant;* David Horn, city of Baltimore, March 31.

There is nothing in the principle, and but little in the arrangement, of this hydrant, different from others in common use. The pipe through which the water enters, under ground, has a socket in it that receives a vertical shaft, up which it is to flow to the point of delivery; the lower end of the shaft fits into, and turns in the socket, as a key in a cock, allowing the water to pass into it when in the proper direction, and when turned round a quarter of a circle, the water in the shaft runs into the ground through a waste hole in the socket.

130. For a mode of *Joining Rail-road plates;* A. Mizick M'Cain, Montgomery, Montgomery county, Alabama, March 31.

A lap is to be formed at the junction of rail-road plates, by which each plate shall be in part over and in part under, its fellow; and so that a spike driven through shall confine both. The manner in which this may be done will be more readily conceived than described; to save circumlocution, therefore, we leave the mode of effecting it to be devised by the ingenuity of the reader, or to be learnt by application at the patent office.

131. For an improvement in *Rail-roads;* Nathan Read, Belfast, Waldo county, Maine, March 31.

The oft-proposed device of a rack on the middle of the rail road, and of a toothed wheel on the axle of the locomotive, is the subject of this patent. The rack is to be made with rounds like a ladder, and the teeth in the wheel are to be larger than usual; these constitute the only change proposed in the mode described.

132. For an *Ointment for Cancers;* Elias Gilman, Licking county, Ohio, March 31.

This ointment has the merit of being a tolerably safe application, which is much more than can be usually said of ointments for the cure of cancer. It consists of finely pulverised sulphate of iron made into an ointment with mutton suet. It is to be spread upon linen, and renewed when necessary.

The cancer is to be washed with a decoction of spikenard and tanners' ooze, and a decoction of yellow oak bark, and sometimes with a solution of potash and water.

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133. For a *Gripe Chuck, for turners;* David Peeler, Boston, Massachusetts, March 31.

This gripe chuck, it appears, is principally intended to hold, and to turn in the lathe, certain tools used by boot and shoe makers, known by the name of heel keys, fore part irons, and fore part beads. These, it is said, can be manufactured at a much cheaper rate, by means of the gripe chuck, than by the common mode. The claim is to the particular kind of chuck described.

Specification of an improvement in the Art of Tanning, granted to Henry C. Locher, Lancaster, Lancaster county, Pennsylvania, administrator of Henry Locher, deceased, March 12th, 1836.

To all to whom these presents shall come, be it known, that Henry Locher, late of the city of Baltimore, now deceased, in his life time, had invented a new and useful improvement in the art of tanning, called a Communicable Leach System in the art of Tanning, and that the following is a full and exact description thereof. A general communication with every vat intended to be used, is made by means of trunks, or tubes, placed on the outside, and about six inches from the top of the vat, and made level so that water may be sent with equal ease in any direction through them; a perpendicular trunk or tube, is placed in one corner of each vat, extending from the top, to within about four inches of the bottom; small tubes are branched off from the main, or horizontal trunk, or tube, and inserted into each of the perpendicular trunks, or tubes, and also into the opposite ends of the vats called handlers, and into the reservoir; other small tubes are made to connect the several perpendicular trunks, or tubes, with the adjoining vats, of those generally termed leaches, so that the liquor or juice of the bark may be transferred, or driven from one vat to another, in any direction. The perpendicular trunks, or tubes, may, to save room in the vats, be placed on the outside, with communication at the bottom.

This plan enables the tanner to multiply the liquors or juices, in the vats termed leaches, to any degree of strength, and at the same time to exchange strong for weak, without mixing scarcely any, and without labour more than drawing the plugs out of the tubes necessary to be opened, and turning the water from the hydrant, or pump, on one or more of the leaches, thus as many as you please will exchange, and the leaches successively recruit in strength. This is done on the philosophical principles of the lighter bodies rising to the top. As for example, to drive the strong liquor out of the vat, cause a light and steady stream of water to fall on the bark in the vat, or on a board laid on top of the liquor, and as soon as the liquor rises to the tube, in the perpendicular trunk, it escapes by that tube, and is let into any other vat that is opened to receive it, and its place is supplied by the water; if the reverse is wanted, let the liquor into the perpendicular trunk, it sinks to, and spreads over the bottom of the vat, and raises the water to the top, where it escapes by the small tube.

False bottoms are useful in this operation, as they prevent the trunks or tubes from being stopped, or clogged, and they receive the settlings.

What I claim as the invention of Henry Locher, deceased, and not previously known, is the trunks and tubes, and the manner of using them.

Henry C. Locher.

Progress of Practical and Theoretical Mechanics and Chemistry.

Earthen retort for generating gas for the purpose of illumination. A patent for a composition for this purpose was secured to Thomas Spinney, of Cheltenham, gas engineer. The materials are—Stourbridge fire-clay, one hundred pounds; burnt Stourbridge fire-clay, twenty pounds; pipe clay, twenty pounds; sand, (which is recommended to be as free from lime as possible) twenty pounds.

The Stourbridge clay, both raw and burnt, are to be mixed together with the sand. The pipe, or potters' clay, must be well dried and broken into small pieces, and afterwards put into a copper, or furnace, containing as much boiling water as may be requisite to dissolve or reduce it to the consistence of thick cream, which is to be added to the other materials previously mixed; and as much more water is to be added as will make the whole mass of such a consistence as will admit of its being tempered in the manner generally practised by potters.

The materials thus combined, may be moulded into retorts of any required form; but the patentee says, I do not mean hereby to confine myself to any particular form or size of retort; they may be made in one or more pieces, as may be found most convenient. If made in one piece, after being dried, it must be brushed over with a glaze, or cement, composed of the following materials in the following proportions: of potters' lead ore, three pounds; sand, four pounds; sulphate of iron, one pound; pipe or potter's clay, one pound. These are to be reduced to fine powder, and mixed with as much water as will bring them to the consistence of paint, and then applied with a brush in the same manner as paint is used by painters. The retort must then be removed to the kiln, and what is technically termed smoked from twenty-four to thirty hours; and afterwards cooled or let down in the usual manner of cooling down earthenware. If the retort is made in more than one piece, the pieces should be formed to fit each other, and joined together with the above mentioned cement or glaze. The retort so formed is also to be brushed over with the said glaze or cement in the manner explained when the retort is made in one piece." Newton's Journal.

Patent invention for assisting the hearing. Mr. Wébster was led to a consideration of this subject, by a sensible diminution of hearing in himself. He adverts to the common practice of applying the hollow of the hand to the back of the ear; to the fact that eastern nations, particularly the ancient Egyptians, (as is evident in antique remains) had the ear more fully developed, larger and more projecting; that this is still the case with savages, who are remarkable for the acuteness of their hearing; that the modes of covering the head have probably produced a permanent compression and diminution of the shell of the ear; and finally, that the Arabs, and occasionally individuals among ourselves, have voluntary power over the muscles of the ear.

The instrument he has invented he terms an Otaphone.

"They are formed from a correct model of the back of the ear, and by fitting all the irregularities of that very uneven and elastic surface, gently

press forward the parts so as to produce a more perfect orbit, and fuller recipient and sound; and being self supported, they occasion no inconvenience to the wearer. By thus concentrating all the powers that nature has provided, a considerable addition to the ordinary force of sound is obtained; dissipating dulness of hearing, when not arising from internal injury, and enabling those in whom this sense is perfect, to preserve the same advantage at a much greater distance. They will, therefore, be found particularly useful in places of public worship, courts of laws, the Houses of Parliament, theatres, and wherever the ordinary powers are insufficient; and by bringing the focus of sound into a more direct line with the face; the expression of the speaker is better preserved than by the unassisted ear.

It is, however, on the advantages they permanently confer, when their use is discontinued, or very rarely resorted to, that the inventor places his greatest reliance for their general adoption. Though obtuseness of hearing arises from many causes, one of the most frequent is the insufficient quantity of sound the external ear collects. When this is the case, the membrane of the tympanum, or drum of the ear, and the internal organs which depend on the vibration for their active employment, become relaxed, and contract the same degress of feebleness as would attach to any other part deprived of its natural action; and this inertness, or stagnation of their powers, renders them unable to surmount those occasional injuries that blows, colds, fevers, &c. create; and thus, from the most common accidents, a permanent injury to the sense is induced, which a more active state of the parts would frequently remove.

The otaphones are based upon the principle, of proportioning their assistance within the limits apparently assigned by nature. The alteration they occasion when worn, is but a restoration of the ear to its original and most useful shape; and for all their subsequent advantages, they depend on that peculiar fabric before described, and which is so happily adapted to the purpose, that no other substance can supply its place. They will, therefore, be found equal to the perfect restoration of the hearing, if any increase of sound, however trifling, is perceptible on their first application, and generally the use for an hour each morning, for a short time, is sufficient; but if the impediment has been of long continuance, and no advantage on trial is experienced, their employment, without previous preparation, will not be recommended. London Mec. Mag.

Manufacture of Beet-root Sugar in Russia. The manufacture of beet-root sugar in the Russian empire has of late become very extensive; there are already no less than twenty-five large establishments for this purpose in different parts. Thinking that the following account of one of the principal of these establishments, viz. Micharlofsky Sugar-works in the government of Tula, the property of Count Bobrinsky, may be interesting to the English public, I send it for insertion in your widely circulated Journal:

The quantity of beet worked in the year 1835 was 260,000 poods=to 85,357 cwt. 0 qr. 16 lbs.; the sugar produced from it, 15,600 poods=5014 cwt. 1 qr. 4 lbs.

Price of a pood of beet, - - -	15 copecks.
Expense in working do. - - -	35 do.
	50

Produce of one pood of beet $2\frac{2}{5}$ lbs. of raw sugar at 1 ro. 10 co. per lb.

The number of men employed 250.

The quantity of land required to produce the beet 350 deciatines—945 acres.

The beet is generally taken from the peasantry instead of the obrok or fine, they, as serfs, would have to pay their baron.

The proprietor of this manufactory is an accomplished and amiable nobleman; his experiment in this case has been highly successful.

One great evil is the impossibility hitherto experienced of keeping the roots any length of time, which makes it expedient they should be worked as soon as possible after they are taken from the ground.

I have been favoured with a specimen of raw and refined sugar from these works, of which I send you a small sample, and am only sorry the distance does not allow me to send a larger one.

The Russian lb. is equal to $14\frac{1}{4}$ oz. English; a pood 40 lbs. Russia=36 lbs. English; a rouble=100 copecks; sterling value $10\frac{1}{2}$d.

Your constant reader, J. K.

Petersburg, *June* 25, 1836.

[The samples sent are excellent; the raw sugar not quite so good as that from the cane, but the refined equal to the best products of our refineries.—Ed. M. M.] Idem.

New mode of preparing Kerm's Mineral and the Golden Sulphur of Antimony. By M. Musculus. For the golden sulphur of antimony, I take—

Lime, slacked with a sufficient quantity of water,	6	parts.
Sub. carbonate of potash, or dry sub. carbonate of soda,	4	
Finely pulverized sulphuret of antimony,	2	
Flower of sulphur,	1	
Sand, well washed and dried,	8	

Mix them all well together, and put them in a funnel or other separating vessel, with a few small pebbles or coarse bits of glass underneath, and cover the mixture with a layer of sand. Pour on this by degrees, cold water, until the filtered liquid is no longer precipitated by hydrochloric acid.

The liquid thus obtained is to be sufficiently diluted with pure water and treated with hydrochloric acid. The precipitate, or golden sulphur of antimony, is to be carefully washed and dried in the common way. The product is about equal to the sulphuret of antimony employed.

To prepare Kerm's mineral proceed in the same manner, only leaving out the flower of sulphur. The liquid obtained is to be treated with a solution of bicarbonate of soda; or by passing through it a current of carbonic acid gas.

This method of preparing these two substances, by displacement, is new, and much more simple and economical, in time and expense, than the usual mode, and the products are as fine and abundant. The proportions may not perhaps be so rigorously exact as further experience may dictate. It is possible that a previous maceration may be useful.

Note by M. Boullay. We have repeated the process of M. Musculus, and find that the golden sulphuret of antimony, which it yields, is very beautiful—the kermes is heavy, and the colour not very good, but by substituting the dry carbonate of soda for potash, and adding to the filtered fluid an equal volume of pure water, deprived of air by heat, prior to the precipitation, we have obtained the kermes in great abundance, light, and of fine bright colour.

Thus the preparation of kermes, till now so embarrassing and capricious, will be extremely easy to practice, in small quantities as well as large, and the pharmaceuist will be no longer excusable in depending on commerce, now he can extract the kermes by simple lixiviation, in the cold, instead of long and reiterated ebullition. Jour. de Pharm.

Preservation of Cantharides. The rapidity with which mites attack cantharides, and the fact that they devour the soft parts of the flies, which are the most active, render any mode of effectual preservation very useful.

An experience of ten years enables me to affirm, that the process of Appert will thoroughly preserve them. The bottles containing the dried and sifted flies, being thoroughly corked, and fastened with double pack thread, are to be placed upright in a kettle of water, which is to be heated to ebullition and kept boiling, for half an hour, the bottle remaining until the water gets cold. They may then be put away in any cool place. If the insects are pulverized on being first taken from the drying stove, again left in the stove for a few hours previous to their being bottled, and afterwards treated as above, they will be still more effectually preserved. The eggs of the mites which adhere to the cantharides, though they may escape the heat of the stove, are destroyed by the boiling temperature, in well closed bottles. Idem.

Preparation of Extracts. The usual mode of obtaining vegetable extracts is by the aid of *heat*, but it is well known that the medicinal properties of compounds are often essentially altered by changes of temperature, and that the proximate principles of plants on which the virtue of extracts depends, may therefore be subverted at the high temperature at which they are sometimes obtained.

M. Guillard proposes to avoid the risk of such a deterioration, by pounding the fresh plant in a mortar, pressing out the juice in the cold, and evaporating it by a current of air from a smith's bellows. In this way he has perfectly succeeded in procuring the extract of *Aconitum Napellus*, after pounding, pressing and filtering, when the temperature of the laboratory did not exceed 10° to 13° cent.

A more perfect mode, perhaps, would be to evaporate by means of a vacuum, without heat, by which the agency of the atmospheric oxygen would be very much avoided, as well as that of increased temperature.

Idem.

Improvement in the Manufacture of Charcoal. It is well known that there is a very great loss of the carbonaceous portion of the wood in the usual careless way in which charcoal is made; and yet the greater density which the coal acquires by this process, than by that of close distillation, renders its quality very superior for the purpose of reducing ores. This is probably owing to the slower carbonisation which the wood undergoes, by which its molecules are dilated with less rapidity and force.

It has been ascertained by experiment, that when the interstices of the wood stacks for charcoal are filled with saw dust and the stack itself covered with it prior to the application of fire, the product of coal is from seven to nine per cent. greater than in the ordinary way. It requires rather more care in the beginning, to get the fire under way, and prevent its going out.

By covering, or mixing the charcoal with tar, before it is put into the

furnace with ore, so great a degree of activity is given to the fire, it may be worth the experiment to ascertain whether it would not be good economy to employ the tar of certain districts in this way.

Jour. Conn. Usuelles, Mai. 1836.

Preservation of Leeches. It has been found that a layer of charcoal in the bottom of the vessel of water in which leeches are kept, tends to their preservation. The writer left 25 leeches in a bottle for three months, expecting on his return to find them all dead, but, to his surprise, they were all alive. He afterwards obtained the best results by adopting this plan—changing the water once a week, a fortnight, or even a month, when inconvenient to do it oftener.

He also finds, that by placing the leeches, when full of blood, on ashes, in a dish, they will in a few minutes completely disgorge themselves, and when well washed in fresh water, will answer for subsequent operations. He has renewed this process more than twenty times, and has yet lost but four leeches.

After four or five days repose, they will perform their service as well as at first.

Idem.

Pork establishment of Mexico. There exists in Mexico a very fine race of hogs, which are regarded as an important article of commerce, and the care which is taken of these animals so far surpasses that which I have seen elsewhere, I think it may be very useful to our farmers, brewers, and distillers, to be made acquainted with the principal details.

The buildings of these establishments include a house for the manager and the workmen, a shop, a slaughter house, a place for singeing, rooms and vessels for the fat and lard, (articles which often supply, in Mexico, the place of butter) other rooms where black pudding is made and sold to the poor, and a soap manufactory, in which all the offals are used. The stables, which contain about 800 hogs, are behind these buildings. They consist of out-houses, well made, thirty feet deep, with overhanging roofs. The entrance is by a low vault, in front of which is an open space twenty-four feet wide, extending the whole length of the yard. In the centre of this is a stone aqueduct, through which flows clear water from a well or spring, the hogs being allowed to pass their snouts only into the stream, through openings in a wall, which prevents their soiling the beverage. It is the only liquid they are allowed to take. They are fed with Indian corn, slightly moistened, and spread upon the floor. The pens and the space on which the animals walk are kept in great cleanliness.

The hogs are in the immediate charge of a number of Indians, attached to the establishment, and who often give them a cold bath, for it is thought that cleanliness contributes to that prodigious increase of fat which constitutes their principal value. It is the business also of these care takers to keep them in good humour. Two persons are employed from morning to night in adjusting their quarrels, and in singing to induce them to sleep. These persons are chosen on account of the strength of their lungs and ability to charm the ears of their amiable associates, which is deemed an affair of no inconsiderable merit!

The proprietor of one of these establishments assured us that the expense of it amounted to 300.000 francs, and that the sales rose to 10,000 a week: the luxury of his equipage indicated, in fact, the possessor of a large fortune.

Idem—Juin, 1836.

Process for determining the existence of Sulphurous Acid in Common Hydro Chloric Acid. By M. Girardin, *Professor at Rouen.* Put into a glass about half an ounce of the hydrochloric acid to be tried, and add to it 120 to 180 grains of the proto-chloride of tin, (common muriate of tin) very white and not altered by the air, stir it with a rod, and add to it two or three times as much distilled water, and agitate the mixture. If no sulphurous acid be present, nothing appears; the salt dissolves, and the fluid only becomes a little disturbed by the action of the air on the salt; but if the smallest portion of sulphurous acid be present, a cloud is immediately perceived, the acid becomes yellow, and when the distilled water is added, the odour of sulphuretted hydrogen is manifest, a brown appearance ensues, and a powder is deposited. These phenomena are so obvious, that there need not be a moment's hesitation with respect to the sulphurous acid.

Sometimes the brown colour does not appear till after some minutes have elapsed. The more sulphur, the deeper it is. The sulphuretted hydrogen is evident only when the water is added. The yellowish brown powder which subsides is a mixture of sulphuret and peroxide of tin.

This process will detect a hundredth part of sulphurous acid in the hydro chloric. The method is now practised in the workshops of Rouen.

Annales de Chim. Mars. 1836.

A new process of Carbonisation, by the aid of the waste flame at the tops of high furnaces. By M. Virlet, *mining engineer.* This process has been practised more than a year by Fauveau-Deliars, forge master at Bièvres, near Grandpré (Ardennes) as well as at several high furnaces in the neighbourhood, with complete success. It seems to have resolved the problem, for a long time a matter of research,—to discover the means of economizing and turning to account, the great quantities of fuel which are entirely lost in the forests, by the common method of coal burning. It consists in allowing the heat of the coal kilns to go no farther than is necessary to drive off the water and the oxidatiny gases. It appears to me to be destined to produce a revolution in forges. A patent for fifteen years has been granted for this improvement, to Houzeau-Muiron, and Fauveau-Deliars.

The following statement is taken from the books of the High Furnace of Montblainville, of results before and after the adoption of the new process:—

Seven cords of wood, of fifty to fifty-two cubic feet, gave, by the old process, four kilolitres (thirty-five cubic feet) of charcoal, producing 800 kilogrammes of cast-iron,—about one ton. To this must be added the market toll, which, in that district, is one-sixth, which brings the actual consumption of charcoal to four and two-third kilolitres for 800 kilogrammes of iron.

Three and a half cords, of the same dimensions, give, by the new method, the same quantity of charcoal, or four kilolitres, producing the same quantity of iron, but less mixed, better, more tenacious, softer, and attended with less loss in blooming, whether by charcoal or pit coal.

There is no toll on the charcoal in the new process, for it is thrown into the furnace as soon as made, and while still warm. It is also proved that the furnace works more rapidly with the new charcoal, increasing the fabrication one-third; so that there is to be added to the advantage before

mentioned, a diminution in the general expenses of production, and a diminution of one-half in the quantity of wood consumed.*

Annales des Mines, 1836.

M. De Milly's *Star Candle Manufactory, Paris.* The French appear to have effected a great improvement in candles, by separating the crystallizable portion of tallow, the stearine, from its other constituents, and rejecting the latter in the composition of their bougies. But stearine itself is a compound of stearic acid and glycerine, and it is the former only which is wanted in the preparation of the most perfect bougies.

To accomplish this more perfect depuration, the stearine is converted into soap, with lime, and this soap is then decomposed by dilute sulphuric acid, forming an insoluble precipitate of sulphate of lime, and leaving the crystallizable stearic acid free.

The saponification of the stearine with lime, is aided by a high temperature, (140° cent.=284 Far.) which produces a corresponding pressure on the liquid, and by suitable agitation. The stearic acid, when separated, is thoroughly washed by hot water and steam, and then set aside to crystallize in tinned vessels.

The cakes thus obtained are broken up, put into sacks, and subjected to the gradual action of a hydraulic press. The greater part of the oleic acid is thus forced out, with a variable portion of the solid acid which it carries with it, depending on the temperature.

The material thus obtained is still more completely purged by a cold pressure in other hydraulic presses, not less powerful, but arranged horizontally. This leaves the solid matter of a splendid pearly white, exempt from odour, but not yet sufficiently purified. It is melted again in water, sharpened with sulphuric acid, washed, and cast into moulds, when it becomes a crystalline mass, and is fit for the preparation of stearine candles.

The strong tendency to crystallization presented a formidable difficulty in the moulding of the candles. In the earlier manufactory of the improved candles this difficulty was overcome only by adding twenty-five to thirty-three per cent of wax, to the purified stearic acid. This added greatly to the cost.

* In a circular which accompanies our French journals, issued by the above patentees, it is stated, that agreeable to the best analysis, wood contains thirty-five to thirty-seven per-cent. of carbon, and that by the common mode of burning charcoal in the forests, only sixteen to seventeen per cent. is obtained. The annual consumption in France of wood, and in the reduction of iron ore, is from thirty to thirty-one millions of francs, more than one half of which, of course, is pure loss, by the common mode of carbonization. By employing the waste heat of the furnace, they are able, with a simple and not costly appendage to convert the wood into a compact charcoal, which possesses great calorific power, and represents almost the whole of the carbon contained in the wood, and preserves in addition, a portion of the hydrogen. The relative expense of the two modes is thus represented.

Old Process.

	Fr.
7 cords of wood produces 40 kilolitres of coal,	42 00
Expense of coal burning in the forest,	3 00
Transport to the furnace of 40 kilolitres,	4 00
One-sixth for toll,	8 16
	57 16

New Process.

	Fr.
$3\frac{1}{2}$ cords of wood, giving also 40 kilolitres of coal,	21 00
Transport of wood at $2\frac{1}{2}$ fr. per cord,	7 00
Sawing and carbonization at the furnace.	3 50
	31 50

Difference in favour of the new process, 25 fr. 66c. G.

An attempt was made at improvement by adding about a thousandth part of arsenious acid, in powder, to the stearic acid. This pretty effectually cut the crystals, (as the workmen termed it) but the process was objectionable, diffusing a disagreeable odour in apartments where many of the lights were burning.

M. de Milly now employs a more simple process, exempt from all reproach, and which requires only five hundredth parts of wax. It consists in disturbing the crystallization by a rapid transition from the liquid to the solid state, effected by dipping the moulds momentarily in water, of about the temperature of congelation of the purified material, and then pouring in the melted substance at a temperature but little higher than the melting point. This ingenious management secures to this fine improvement all the success that could be hoped for. The manufacture has become greatly extended; the wholesale price has been lowered from 2 fr. 25 c. to 1 fr. 75 c, and the retail price from 2 fr. 50 c. to 2 francs the metrical pound, while at the same time the quality of the article is much improved. A steam generator is used in De Milly's factory, for heating and in most of the mechanical operations, and about eighty people, men, women and children are employed in it. Bull. d'Encour. Mars. 1836.

Improved Perpetual Oven. The silver medal was granted to *Jametel & Lemare,* for an oven, the fuel of which is placed under ground, and in large mass. The doors of the furnace and ash pit being closed, no air gains access, except what filters as it were through the masonry. By this means the combustion continues a long time. The oven being long and continuous, the air which enters it is at first much heated, but being gradually cooled by the evaporation from the bread, it descends by its gravity, and again enters the oven to renew the process, thus maintaining a continued current, which regulates the temperature. Idem.

The Prompt Copyist. An ink of a particular consistency is fabricated by *M. Lanet,*—and from a page written with it, two impressions may be taken on varnished or waxed cloth. The powder of a hygrometic ink is then spread on the cloth, and adheres only to the characters impressed. The surface of the cloth is easily moistened, the dampness attaching itself only to the powder, leaving the rest of the cloth free. Two impressions are then taken from each of the proofs, making, with the original letter, five copies, all perfectly legible. The silver medal was granted to M. Lanet. Idem.

Improved Tanning. M. Renou has devised a method of tanning rabbit skins, so as to render them at thick as cow skin. With these he tans boot legs and the upper leather of shoes, so as to be without a seam, leaving the hair inside. Leggings, buskins, caps, &c. are also manufactured of this new material. Rabbit skins which before were worth but 10 centimes, now sell from 1 fr. 50 c. to 4 francs. Cat skins may be treated in the same manner. This invention obtained the platina medal. Ibid.

Pink Colour employed in English Porcelain. By M. Brongniart. The beautiful English porcelain, known by the name of *Iron Stone,* is figured with a pink or purplish colour, very agreeable to the eye, the preparation of which has been kept a secret. M. Malaguti, attached to the Royal Manufactory at Sèvres, having analyzed this colour, finds it to be composed of

stannic acid 100 parts, chalk 34, oxide of chrome 1, silex 5. Combining these materials by a strong calcination, he obtained a colour at least as fine as that of the English. The trials that have been made of it at the factory of *L. Lebeuf*, at Montereau, on the fine ware called *opaque porcelain*, have perfectly succeeded. Bull. d'Encour. Mai. 1836.

New method of feeding calves. M. Labbé, member of the council of administration of the Agricultural Society, finding that the carrot is one of the most nutritious kinds of food for cows, greatly increasing the quantity of milk, and furnishing a richer cream, he reduced half a pound of carrots to a pulp, boiled it four or five minutes in half a pint of water, and added the whole, in two portions, to the noon and evening mess of a calf, five days old. The same food, as a substitute for milk, was increased daily, so that on the eleventh day the boiled carrots were given as the entire food, except that after the eighth day a boiled potatoe was added to each of the three daily messes. The calf not only thrived finely, but grew so fat, that on the twentieth day, not intending it for the butcher, they were obliged to moderate the food. Idem.

Physical Science.

BRITISH ASSOCIATION.

Large lens of rock Salt. Sir David Brewster having been authorized to expend £80 in the construction of a lens of rock salt, stated that through the kindness and activity of Dr. Traill, he had procured from Cheshire several splendidly transparent and homogeneous crystals of rock salt; and that he had little doubt that these would in every way answer the desired end; but that, as a lens, when constructed of this material, would require to be adapted to a certain glass lens or lenses—and as the construction of each of these and their mutual adaptation was a matter requiring not only the nicest mechanical manipulation, but also a skill and knowledge of principles which was not to be expected in workmen of an ordinary class—he had most reluctantly been compelled to abstain from an attempt at the actual construction, but he hoped very soon to have it in his power to accomplish this most desirable object. Athenæum.

Tide observations at Liverpool and London. M. Lubbock being called upon to give an account of the recent discussion of tide observations, for which a liberal grant of money had been made by the Association, rose and stated, that through the indefatigable exertions of Mr. Dessiou, considerable progress had been made in the reduction of the observations made at Liverpool by Mr. Hutchinson.

The diurnal inequality of difference between the superior and inferior tide of the same day, which in the Thames was very inconsiderable, if not insensible, was found at Liverpool to amount to more than a foot; a matter upon which the learned gentleman laid considerable stress, as calculated to lead to important practical results. The object of these reductions was to compare the results of theory with these observations, and with those of Mr. Jones and Mr. Russell, made at the port of London. The principal objects of comparison were the heights of the several tides, and the intervals between tide and tide; and these were examined in their relations to the parallax and declination of the Moon and of the Sun, and in reference to local, and what may in one sense be called accidental causes, as storms, &c.

Of this latter, one of the most curious, as well as important, is the effect of the pressure of the atmospheric column. The learned gentleman stated, that M. Daussy had ascertained, that at the harbour of Brest a variation of the height of high water was found to take place, which was inversely as the rise or fall of the barometer, and that a fall of the barometer of 0.622 parts of an inch, was found to cause an increase of the height of the tide, equal to 8.78 inches in that port. To confirm this interesting and hitherto unsuspected cause of variation, had been one principal object of the researches of the learned gentleman, and at his request, Mr. Dessiou had calculated the heights and times of high water at Liverpool for the year 1784, and compared them with the heights of the barometer, as recorded by Mr. Hutchinson for the same year; and by a most careful induction, it had turned out that the height of the tide had been on an average increased by one inch for each tenth of an inch that the barometer fell, *cœteris paribus;* but the time was found not to be much, if at all, affected. Mr. Lubbock then proceeded to examine the semi-menstrual declination and parallax correction, and stated that the result was a remarkable conformity between the results of Bernouilli's theory, and the results of observations continued for nineteen years at the London Docks. But to render the accordance as exact as it was found to be capable of being, it was necessary to compare the time of the tide, not with that transit of the Moon which immediately preceded it, but with that which took place about five lunar half days. To explain this popularly, the learned gentleman stated, that however paradoxical it might appear to persons not acquainted with the subject, yet true it was, that although the tide depended essentially upon the Moon, yet, any particular tide, as it reaches London, would not be in any way sensibly affected, were the Moon at that instant, or even at its last transit, to have been annihilated; for it was the Moon as it existed fifty or sixty hours before, which caused the disturbance of the ocean, which ultimately resulted in that tide reaching the port of London. The learned gentleman then exhibited several diagrams, in which the variations of the heights of the tide, as resulting from calculations founded upon the theory, were compared with the results of observations. The general forms of the two curves which represented these two results, corresponded very remarkably; but the curve corresponding to the actual observations, appeared the more angular or broken in its form, for which the learned gentleman satisfactorily accounted, by stating that the observations were neither sufficiently numerous, nor sufficiently precise, from the very manner in which they were taken and recorded, to warrant an expectation of a closer conformity, or a more regular curvature. When it is recollected that the observations are at first written on a slate, and then transferred to the written register, by men otherwise much employed, and whose rank in life was not such as would lead us to expect scrupulous care, it was not to be wondered at, if occasionally an error of transcript should occur, or even if the observation of one transit was set down as belonging to the next. When to these circumstances it was added, that the tide at London was in all probability, if not certainly, made up of two tides, one having already come round the British Islands, meeting the other as it came up the British Channel, it was altogether surprising that the coincidence should be so exact; and it was one among many other valuable results of these investigations, that it was now pretty certain that tide tables constructed for the port of London, by the theory of Bernouilli, would give the height and interval with a precision quite sufficient for all practical purposes, and which might be relied on as sufficiently exact,

when due caution was used in their construction, and the necessary and known corrections applied. In conclusion, Mr. Lubbock said, the Observations for the port of London had now been continued from the commencement of this century, and those for Liverpool, as we understood, about twenty-five years.

Prof. WHEWELL observed, that as, in the discussion of the relative level of land and sea, the tides of the ocean were an important element, he should preface the remarks upon that subject, which he intended to submit, by making a few observations upon the very valuable communication of his friend Mr. Lubbock. This communication he highly eulogized, and pointed out to the Section the importance of many of the conclusions, should they prove hereafter to be generally applicable: but he expressed strongly his fears that this would not be the case. Observation had, in the instance of the tides, far outstripped theory, for many reasons, which it would be impossible to detail; but among the most prominent were the complexity of the problem itself involving the astronomical theories both of the Sun and Moon; the masses of these bodies; the motions of disturbed fluids, and local causes tending to alter or modify the general geographical effect of the great tide-wave at any particular place. It was upon a careful review of these considerations, that he was led to fear that it would be still many years before theory would become so guarded and supported by local observations; as to afford a sufficiently correct guide to be implicitly relied on in these speculations. He instanced the tides of the British Channel, which, in consequence of their excessive magnitude, afforded magnified representations of the phenomena, by which the deviations become more remarkable. At the port of Bristol, the tide rose to a height of fifty feet, while towards the lower part of the Channel they only rose twenty, and along other parts of the coast not quite so high. The most striking of Mr. Lubbock's conclusions was that by which it appeared that the ocean assumed the form of the spheroid of equilibrium, according to the theory of Bernouilli, but at five transits of the Moon preceding the tide itself. By the calculations of Mr. Bent, however, it would appear, that although the observed laws of the tides at Bristol might be made to agree with Bernouilli's theory of equilibrium tides, by referring them to a certain anterior transit,—so far as the changes due to parallax were concerned, as also as far as those due to declination were concerned,—yet it turned out that this anterior period itself was not the same for parallax as for declination. The two series of changes have not therefore a common origin or a common epoch; so that in fact there is no anterior period which would give theoretical tides agreeing with observed tides; and, therefore, at least the Bristol tides do not at present appear to confirm the result obtained by Mr. Lubbock from the London tides. The learned gentleman then illustrated these views by diagrams, by the aid of which he explained to the Section the luni-tidal intervals, and the curve of semi-menstrual inequality—(this latter term, and the doctrine connected with it, was introduced into the subject of the tides by the learned gentleman himself, and, as is admitted by all acquainted with the subject, with the most valuable result.)

Relative Level of Land and Sea. Prof. WHEWELL then proceeded to give an account of the proceedings of the committee appointed to fix the relative level of land and sea, with a view to ascertain its permanence, or the contrary. He observed, that the Committee had not taken any active, practical steps for the important purposes for which they were appointed, be-

cause they had met with many unexpected difficulties requiring much consideration. It was, however, intended to appoint a Committee for the same purposes, who should be furnished with instructions founded upon the views at which the former committee had by their labours and experience arrived. One method proposed was, that marks should be made along various parts of the coast, which marks should be referred to the level of the sea; but here the inquiry met us in the very outset—what is the proper and precise notion to be attached to the phrase the *level of the sea?* Was it high water-mark, or low water-mark? Was it at the level of the mean tide, which recent researches seemed to establish? In hydrographical subjects the level of the sea was taken from low water, and this, although in many respects inconvenient, could not yet be dispensed with, for many reasons, one of which he might glance at—that by its adoption, shoals which were dry at low water, were capable of being represented upon the maps as well as the land The second method proposed appeared to the learned Professor to be the one from which the most important and conclusive results were to be expected. It consisted in accurately leveling, by land survey, lines in various directions, and by permanently fixing, in various places, numerous marks of similar levels at the time; by the aid of these marks, at future periods, it could be ascertained whether or not the levels, in particular places, had or had not changed, and thus the question would be settled whether or not the land in particular localities was rising or falling. Still further, by running on those lines, which would have some resemblance to the isothermal lines of Humboldt, as far as the sea coast, and marking their extremities along the coast, a solution would at length be obtained to that most important practical question,—what is the proper or permanent level of the sea at a given place? Until something like this were accomplished, the learned Professor expressed his strong conviction of the hopelessness of expecting any thing like accuracy in many important and even practical cases. As an example, he supposed the question to be the altitude of Dunbury Hill referred to the level of the sea. If that level of the sea were taken at Bristol, where the tide rises, as before stated, fifty feet, the level of low water would differ from the same level on the sea coast at Devonshire, where the sea rises, say eighteen feet; and supposing, as is most probable, the place of mean tide to be the true permanent level by no less a quantity than sixteen feet, which would therefore make that hill to appear sixteen feet higher, upon a hydrographical map constructed by a person taking his level from the coast of Devonshire, than it would appear upon the map of an engineer taking his level at Bristol. In the method proposed, the lines of equal level would run, suppose from Bristol to Ilfracomb in one direction, and from Bristol to Lyme Regis in the other, and by these a common standard of level would soon be obtained for the entire coast.

Professor Sir William Hamilton rose to express the sincere pleasure he felt at the masterly expositions of Mr. Lubbock and Professor Whewell. One conclusion to which Mr. Lubbock had arrived was to him peculiarly interesting, viz. that by which it appeared that the influence of the Moon upon the tides was not manifested in its effects until some time after it had been exerted, for a similar observation had recently been made by Professor Hansteen respecting the mutual disturbances of the planets.—Mr. Lubbock rose to say, that the agreement between the results calculated from the theory of Bernouilli and those obtained from actual observation, were much more exact than Professor Whewell seemed to imagine; in truth, so close was the

agreement, that they might be said absolutely to agree, since the difference was less than the errors that might be expected to occur in making and recording the observations themselves.—Mr. Whewell explained that he wished to confine his observations to the Bristol tides, as these were the observations to which he had particularly turned his attention; and, with respect to which, he should be able, at the present meeting, to exhibit diagrams to the section, which he felt confident would amply bear out his assertions respecting these tides.—Mr. Lubbock stated, that so near, indeed so exact, had been the coincidence between the observations made at London and Liverpool, and the theory, that he was strongly inclined to believe that that coincidence would be found at length to be universal.—Professor Stevelly inquired from Mr. Lubbock, whether he did not think it quite possible that local causes might exist, which would be fully capable of producing the deviations from the theory of Bernouilli; as, for instance, in the case of Bristol, so ably insisted upon by Professor Whewell, where the causes of the extraordinary elevation are the land-locking of the tide-wave, as it ascends the narrowing channel, and the reflexions of other tide-waves from several places. Now, particularly in the case of reflex tides, may it not so happen, and does it not, in fact, happen in several places, that they bring the actual tide to a given port at a time very different from that at which the influence of the Moon and Sun, if unimpeded, would cause it to arrive, and thus separate, as Professor Whewell had stated, the origin or epoch of the variations due, suppose to parallax and declension, and even cause other deviations from Bernouilli's theory?—Mr. Lubbock replied, that unquestionably it might so happen; but, in his opinion, the discussion of a few observations, like those made at Bristol, could not be expected to point out very exactly the origin or epoch of either of the variations of parallax or declination, with sufficient exactness, to furnish secure data for determining that they did not correspond to any one, common, previous transit of the Moon.

Jerrard's Mathematical Researches. Prof. Sir William Hamilton read his report on Mr. George B. Jerrard's mathematical researches, connected with the general solution of algebraic equations. He wished, in the first place, to inform the Section, that no part of the grant of 80*l.* had been expended, which the Association had so liberally placed at his disposal for the purpose of procuring the assistance of persons competent to verify, by numercial computations, the method of Mr. Jerrard. The reason that he had not deemed it necessary to resort to this expense was, that he had, at a very early period after the meeting of the British Association in Dublin, satisfied his own mind that the method of Mr. Jerrard entirely failed in accomplishing the solution of equations of the fifth and sixth degree; and he trusted that he should be able to lay before the Section, with as much clearness as the abstruse nature of the subject would admit of, the principal steps of a demonstration, which, to the mind of the learned Professor himself, at least, carried a complete conviction, that the method of Mr. Jerrard was not applicable until the equation, as a minor limit, had reached the seventh degree. In order that he might carry the Section fully along with him, Professor Hamilton stated, that it would be necessary to give again a rather detailed account of the peculiarities of the very ingenious notation, devised by Mr. Jerrard, for denoting certain algebraic processes, resorted to in the application of his method. The Professor then proceeded to detail to the Section the several steps of Mr. Jerrard's method, clearly marking the steps

previously known to analysts, and such as Mr. Jerrard had the merit of originating. The principal peculiarity of *formulæ* seemed to be, that in an equation, transferred in a particular manner for the purpose of eliminating the co-efficients of the original equation, the co-efficients were so ingeniously obtained as to be entirely independent of the degree of the original equation, and therefore to be of a similar form in all possible equations, the solutions of which were sought. As soon as he had prepared these formulæ, the Professor proceeded to demonstrate to the Section, that from the very nature of their connexion with the original equation, they must fail in giving its solution, where it only rose to the fourth dimension, because he showed that this would involve the solution of an equation of the sixth degree, as a preliminary step. Equations, however, of this degree had been long solved, and it was only, therefore, in connexion with the generality of Mr. Jerrard's method, that its failure, as regarded them, was of any consequence. He then proceeded to give a similar demonstration of its failure, as regarded equations of the fifth and of the sixth degree; and during his discussion of this step of his demonstration. he took occasion to show that Mr. Jerrard's method had succeeded in reducing equations of the fifth degree to tables of double entry—a discovery, upon the value of which he enlarged considerably, and highly eulogized and complimented the author; insomuch, that he stated that if the method had accomplished nothing but this alone, Mr. Jerrard would have received the congratulations of the scientific world. He then proceeded to show, that unless the index of the equation reached as a minor limit the number seven at least, a certain intermediate equation, concerned in the elimination, would be met with, along with a multiple of it, which, therefore, would not give a number of distinct results sufficient to complete the eliminations; but, beyond that degree, he stated that he had satisfied himself that Mr. Jerrard's method would afford solutions of equations, which, even if they should, from their complexity, or other causes, be useless to the practical or merely arithmetical algebraist, yet to those engaged in prosecuting inquiries involving purely symbolic algebra, he felt confident they would afford facilities and general methods of investigation, hitherto almost unlooked for and unexpected.

Mr. Babbage complimented Sir W. Hamilton upon the very lucid exposition which he had given of a subject which he characterized as bordering upon the very extremest limits of human knowledge, and congratulated Mr. Jerrard upon the success with which he had contrived so effectually to distinguish between the symbols of operation and those of quantity, in expressing the results of elimination. Engaged, as it was well known he was, in a branch of practical numerical science, he could not suffer himself to be supposed to look with indifference upon a discovery which, if it should even fail in affording any practically important assistance to his particular branch, must yet be admitted to afford the strongest promise of advantage to the more purely abstract branch of algebraic investigation.—Professor Peacock observed, that during the progress of the discussion of this question he had not failed to remark the many advantages which must result to algebra from Mr. Jerrard's method, from the collateral improvements to which the prosecution of his principal object had led, partly in suggesting new, and hitherto unexplored, methods of elimination, and partly by leading to a notation, which so clearly distinguished between the marks of quantity and the observations and changes which were to be resorted to in reference to them; but as to the result itself, he need characterize it no higher, when he added, that it was an advance in the science, which it did not appear that the cele-

brated La Grange had ever contemplated, and which was not approached by the result of Stchernhausen.

Experiments with a view to determine the Interior Temperature of the Earth. Prof. Phillips stated that this subject had for a long period engaged the anxious attention of scientific men, both at home and upon the continent; that the most accurate, as well as numerous, experiments indicated a decided elevation of temperature as a more depressed station below the earth's surface was attained; even when the depths descended to were small, this elevation of temperature became large enough to arrest attention; in fact, the temperature of the air, of the water, of the rocks, and of the soil, was found to augment as we descended. But in order to ascertain, if possible, what portion of this heat arose from, or was connected with, an elevated temperature of the internal parts of the globe, as well as to ascertain whether the causes of these were local or universal, and, if possible, to arrive at the law of its distribution, it was deemed a matter of much importance to get rid altogether of the effect of the air's temperature upon the thermometer, as also the action of water, because the sources of the water in mines, &c. must be in most cases entirely beyond the reach of observation. All these circumstances induced the committee appointed by the Association to conduct experiments upon this subject, to take the temperatures of the rocks themselves alone, as the fundamental experiments. With this view, they had no less than thirty-six thermometers made and carefully compared, and, although they well knew that these thermometers, after all the care which had been bestowed upon their construction, were by no means perfect or exact, yet, as their errors had been carefully noted, by a comparison with the standard thermometers of the Royal Societies of London and Edinburgh, and each thermometer numbered, the errors admitted of an easy correction. Many of these thermometers had been already placed under the care of persons adequately instructed to conduct the requisite experiments, and some of them were still in the possession of the committee, who would gladly place them in the charge of any person giving adequate security that they should be applied to the purpose for which they had been procured. The method of using them was this: a hole large enough to receive one of the thermometers, was first drilled into the solid rock, at the bottom of the mine, pit, or other proper place of observation, to the depth of two or three feet at least; into this the thermometer was then introduced and suffered there to remain for a number of days sufficient to ensure the attainment of the temperature of the rock itself. The temperature of the air at the mouth of the pit, and, if possible, the mean temperature of the place, must be observed or obtained. Professor Phillips then stated, that observations had been made in this manner, and with some of these instruments, under the directions of Professor Forbes, at mines in the Lead Hills, in Scotland, and that Professor Forbes would take some early opportunity of bringing these observations more immediately under the notice of the Section; at Newcastle, under the direction of Mr. Briddle; at Wearmouth, under the care of Mr. Anderson; near Manchester, and at Northampton, under the direction of Mr. Hodgkinson; and within a few days, Professor Phillips had been enabled, through the kindness of a friend, to place a thermometer in a deep coal mine at Bedminster, in this immediate vicinity (Bristol.) The results of these observations, so far as they had as yet proceeded, amply confirmed the fact of the increase of temperature in the parts under the earth's surface. As one example, the Professor

stated, that in a mine, the perpendicular depth of which, below the surface, was 525 yards, the thermometer in the rock stood at 78°, while the temperature in the open air at the mouth of the mine, varied from 30° to 80°, the mean temperature of the place being 47½°.

Prof. Forbes then gave, from memory, an account of the experiments which he had been the means of instituting in the Lead Hills. Before he did so, however, he wished to state that he had been informed that an artesian well had lately been met with in granite, and he then gave a general description of artesian wells. It was to this effect: that heretofore, in making borings in certain districts through certain alternations of clays, and at length through certain rocks, a supply of water was reached, which rapidly rose through the boring to the surface, and continued to overflow at the top sometimes, as the term fountain indicated, in considerable quantity, and with considerable force. He instanced the artesian wells, or fountains, of the London clay districts; and added, that the temperature of these waters was found universally to increase with the depth of their source beneath the surface of the earth. Heretofore, no such well had been obtained by boring through the granite; and if the account, which he had received, were correct, and of its correctness he entertained little doubt, this would be a matter of considerable interest as well to the geologist as to those who were engaged in scientific pursuits similar to those now under consideration. The observations made under his direction in the Lead Hills, alluded to by Professor Phillips, were almost entirely conducted by Mr. Irvine. These observations were particularly interesting, from the fact, that the mines, in consequence of a strike among the workmen, had not been worked for many months, and at the same time it most fortunately happened that they were self drained, that is, by machinery worked by external power, without the aid of either animals or steam. This most fortunate concurrence of favourable circumstances, which could be expected to be met with in so very few instances, at once disembarassed the observations from many sources of error, which, but for this, would have still left considerable doubts of the results being, partially, at least, affected by the heat generated by animals residing and working in the mines, as well as of artificial fires kept up for the purposes of ventilation or of originating power. It was upon these grounds that he perceived the importance of them, but had it not been for the valuable assistance afforded him by Mr. Irvine, who descended into the mine, and placed the thermometer and made the observations, he could scarcely have been as successful as the results already obtained warranted him in hoping he should be. These results, which, of course, had not as yet reached the degree of accuracy which he still looked for, lead to the conclusion that the temperature in that mine increased about 50 of Fahrenheit for a descent of ninety-five fathoms.—Professor Stevelly stated, that as practical utility was one of the principal objects of the British Association, he might be permitted to add, that the waters of these wells, in consequence of their temperature being in general elevated above the mean temperature of the place at which they delivered their waters, had been applied to the very important practical purpose of freeing machinery of ice in winter, insomuch, that by their instrumentality, machinery, such as water wheels, &c., which had always previously been clogged by ice for a considerable part of the winter, to the great loss of the owner's manufactory, were, by the aid of the waters of these fountains, kept constantly free; while the same water has been, in some instances, conducted through the factory itself, with a view to keep up a uniform and elevated temperature

within its walls, thus affording a second and a very valuable practical application.

London Athenæum, No. 461.

Progress of Civil Engineering.

Health of Cities—Improvement of London.

Our last number contained the substance of a Report on the plan of a celebrated artist, J. Martin, for the improvement of the British Metropolis, preceded by some general remarks on the importance of a due consideration of the plans upon which our own cities are regulated, in reference to salubrity and comfort. We now insert the strictures which have been made upon Martin's scheme of improvement, by a writer in the London Architectural Magazine.

"That we have thought on the different subjects treated of in this *Report*, will appear evident from two articles; the one, *A Plan for saving the Manure lost in the common Sewers of London, and rendering the Thames Water fit for domestic Purposes;* and the other, *On Breathing Places for the Metropolis, and other Towns*, which appeared in the *Gard. Mag.*, vol. v., for 1829. It will be seen, even from the titles of these articles, that we approve of the general principle of preventing the London sewers from emptying themselves into the Thames; and of saving every particle of the manure which they contain. We differ, however, from Mr. Martin, in preferring several intercepting sewers to one, which one, from its unavoidable magnitude, we think would be liable to very great risks in times of heavy rain, or severe frost, notwithstanding the precaution of flood-gates; which, even if found efficacious, would, in a great measure, defeat the purpose of the sewer, by contaminating the water of the Thames.

Another difficulty regarding Mr. Martin's plan, is the quantity of sewer water that will require to be either evaporated, or run off, from the manure reservoirs. This quantity would necessarily be immense, and may be estimated by the quantity brought into London by the different water companies, or obtained from wells, &c., in addition to what falls from the clouds. If this water is neither evaporated nor run off, then the contents of the sewers must be conveyed in their present state to the grounds where they are to be employed as manure; but to convey all the water contained in the sewers of London in "covered barges, or properly constructed land-carriages," may be safely pronounced impracticable. We have no doubt of the utter impossibility of evaporating this water during the winter months, and, consequently during that season at least, it must be run off. Mr. Martin has not stated how he means to dispose of it. It is certain that, if it found its way into the Thames any where above Gravesend, it would, from the influx of the tides, contaminate the water as far as London and, if it remained in ponds in the neighbourhood of the reservoirs of manure, it would cover great part of the surface of the Essex marshes. The superfluous water, we think, would be best got rid of by running it off from the manure reservoirs into an open sewer, parallel to the Thames, and continued as far as the sea, and then allowing it to escape among the sea water, which is already unfit for human use. The salt seas, then, in every part of the world, appear to be the only natural cess-pools, or reservoirs, for the sewers of great cities; and, unquestionably, the only true principle of arranging the sewerage of all cities, towns, and even villages, which are built

along the banks of rivers, is by forming sewers parallel to those rivers, and not so far from them as to occasion any difficulty in the sewers receiving the drainage of the space between them and the margin of the river.

If the building of London were to be recommenced, the first step should be to form two sewers parallel to the Thames, though at such a distance from it as to admit of forming docks, basins, &c., on its banks; but, as this has not been done, the question is (now that the ground is covered with houses and streets, and various docks, basins, and canals,) how to remedy the evil? We are inclined to think it will be better done by two or three intercepting sewers, at different distances from the Thames, than by one so close to that river, and so large, as that which Mr. Martin proposes. One sewer might be carried at about the distance of the Strand, more or less, as might be convenient; a second, about the distance of Holborn, which should intercept all the sewers between it and a third, about the distance of the New Road, which should, in like manner, intercept all the sewers northwards. The directions of these sewers must necessarily vary with the inclination of the surface, so as to keep the bottom of each sewer of one uniform declivity; and they might all unite in an open sewer, or ditch, a few miles down the river, which ditch might be continued to the sea, or to the point where the water of the Thames became decidedly salt. Where the sewer met with rivers or canals, it might cross beneath them in inverted siphons, such as those employed in conveying the water used in irrigation in Lombardy. Indeed, a considerable part of the water of this sewer, and, possibly, at some seasons of the year, the whole of it might be employed in irrigation; in which case it should be raised from the sewer by machinery, impelled by steam, and conveyed to the fields intended to be irrigated by open ditches, or in pipes. By the latter mode, it might be conveyed many miles in the interior, even over a hilly country: and, perhaps, such a mode of irrigation would even now pay the British cultivator.

If intercepting sewers of the kind described were to be carried into effect in London, they might all be so deep under ground as to be excavated by tunneling, and, consequently, the surface, and the buildings on it, would be scarcely at all disturbed. The expense, also, of this mode of excavating sewers, we think, might be more readily ascertained than that of forming one immense tunnel in Mr. Martin's manner; as it could not vary much from that of the present ordinary sewers. One obvious advantage of this mode of forming intercepting sewers is, that, by dividing the water to be conveyed away into different portions, there never could be any danger from the stoppage of a sewer, at all to be compared to that which would result from the bursting of one main sewer, which should contain the contents of all the sewers of the metropolis on one side of the river. Anothe advantage is, that, by having the intercepting sewers considerably deeper than the ordinary ones, there would be no occasion to stop up the ends of the ordinary sewers which crossed them; in consequence of which, if any intercepting sewer were at any time choked up, the superfluous water would readily find its way through the ordinary sewer, into the next intercepting sewer, or, at all events, into that which was on a lower level. Again, a system of intercepting sewers would not interfere with any of the docks, ro with the canals which join the river, which the scheme of a single sewer adjoining the Thames, we think, would certainly do.

If such a system of sewerage were formed on the intercepting principle, or, indeed, on any other, to be effective in preserving the purity of the water of the Thames, it must be commenced above Brentford, or rather,

perhaps, at Oxford, and continued, at least, for some miles below Gravesend. Wherever the sewer did not pass through towns or villages, it might be an open ditch; and it would form, during its whole length, a valuable source of liquid manure to the adjoining lands. Of course, it could easily be carried under rivers, streams, or canals, connected with the Thames, by the mode already suggested; and such proprietors as chose might have a covered ditch instead of an open one. Other proprietors might have iron pipes, even though they lived at several miles distance, communicating with the sewer; and, by applying pumps to these pipes, they might obtain water for the purposes of irrigation at pleasure.

We shall, perhaps, surprise our readers when we state, as our candid opinion, that we do not think the "magnificent promenade on each side of the river, to be formed by the conversion of the roofs of the colonnaded wharfs into parapeted walks," would be at all desirable. A quay, or broad terrace walk, along the banks of the river, we think, would be highly so; but to stop up the ends of the streets by this colonnade, and its parapeted roof, would, we think, prevent their proper ventilation; and we are sure that it would totally destroy the beautiful views of the river, now obtained by looking down them; which views, in a large city, more particularly in summer, are peculiarly refreshing to the sight, from the idea of coolness conveyed by the vast expanse of water, as contrasted with the dust and heat of the streets. Were such a colonnade and public walk executed, there can be no doubt it would produce a very grand impression at first sight; but by no means so much so as might be imagined. This, a little reflection will convince any philosophic architect, must necessarily arise, from the circumstance of its ground plan having neither regularity nor symmetry; that is, of its consisting neither of one or more straight lines, nor of one or more regularly curved lines, nor of such a combination of these as would suffice to form a symmetrical whole. In the absence of both regularity and symmetry, the monotony of the impression of grandeur would, we think, soon become wearisome. In proof of this, we may refer to the elevations of the houses in the streets on the banks of the Spree, at Berlin; to those on the banks of the Neva, at St. Petersburgh; and even to those on the banks of the Arno, in some parts of Florence and Pisa. If, instead of the proposed colonnaded quay, we had only an architectural basis, such as would be formed by a river wall, like those in the cities mentioned, and a broad promenade within it, we should, in the elevations of the houses facing the river, greatly prefer the variety that would be produced by the mixture of public and private buildings, by the different purposes for which both were erected, and by the wealth, taste, and even no taste, of the erectors, to any regular design whatever. In short, we are of opinion that Mr. Martin's colonnade, grand and sublime as we allow it to be, if executed on either, or on both sides of the Thames, would take away half the interest and variety which at present attaches to that river.

By adopting the principle of having sewers parallel to all rivers and streams throughout the whole of their course, every particle of manure, and more especially of liquid manure, would be saved. In thinly inhabited countries, sewers of this kind are out of the question; but in such as are densely peopled they seem to be absolutely necessary for the preservation of the purity of the water of the rivers. There must, we think, be something radically bad in the geographical police of a country, in which not only the water of all the rivers is more or less polluted, but in which an

immense quantity of the most valuable description of manure is habitually and irrecoverably lost.

If a system of intercepting sewers were adopted, extending from Brentford or Windsor to Gravesend, there could be no difficulty in supplying London with pure water from the Thames. If, on the other hand, the system of making all the rivers of a country serve as its main sewers, as is at present the case, not only in Britain, but throughout the world, is to be persevered in, it may be reasonably pronounced impossible ever to obtain perfectly pure water in large quantities, in densely peopled countries; since every part of the rivers of such countries must contain more or less of those fæcal impurities, which, according to Dr. Granville, neither subsidence nor fermentation will remove.

With this view of the subject, we do not approve of Mr. Martin's plan of forming a dam across the Thames, and supplying the metropolis from the water above it, for though we admit that this water is much more pure than that of the Thames opposite London, yet still it would contain all the impurities of Brentford, and the tributary sewers from the intervening villages. Mr. Telford's plan is not without objections of the same kind: in short, there is no plan by which immense quantities of perfectly pure water can be obtained in a densely peopled country like England, but by preserving the purity of the rivers by intercepting sewers, or by raising the water from inferior strata, in which there may prove to be an abundant supply. When we consider the advantage that would arise from saving and applying to the surface of the soil the immense quantity of liquid manure now utterly lost, and, at the same time, the desirableness of having pure water in all large cities, we cannot help thinking that the subject of intercepting sewers deserves the attention of government, and of the proprietors of lands in the country, no less than of the dwellers in towns.

Mr. Martin's plan for a parapeted public walk by the side of the river is magnificent; but, as we have already stated our objections to the proposed structure, it is unnecessary here to add anything more respecting it. An uncovered parapeted quay, like that which borders both sides of the Neva, at St. Petersburg, we should wish to see carried along both banks of the river; and this, besides facilitating business in business hours, would form an excellent promenade in the evenings, and on Sundays.

In the year 1829, in consequence of an attempt made in parliament to procure a bill for enclosing Hampstead Heath, our attention was directed to the subject of public walks and breathing places; and the following is an extract from an article which appeared in the Gardener's Magazine for that year;—

"A late attempt in parliament to enclose Hampstead Heath has called our attention to the rapid extension of buildings on every side of London, and to the duty, as we think, of government to devise some plan by which the metropolis may be enlarged so as to cover any space whatever with perfect safety to the inhabitants in respect to the supply of provisions, water, and fresh air, and to the removal of filth of every description, the maintenance of general cleanliness, and the despatch of business. Our plan is very simple; that of surrounding London, as it already exists, with a zone of open country, at the distance of say one mile, or one mile and a half, from what may be considered the centre, say from St. Paul's. (*fig.* 143.) This zone of country may be half a mile broad, and may contain, as the figure shows, part of Hyde Park, the Regent's Park, Islington, Bethnal Green, the Commercial Docks, Camberwell, Lambeth, and Pimlico; and it may be suc-

ceeded by a zone of town one mile broad, containing Kensington, Bayswater, Paddington, Kentish Town, Clapton, Lime House, Deptford, Clapham, and Chelsea: and thus the metropolis might be extended in alternate mile zones of buildings, with half mile zones of country or gardens, till

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1. Finchley common; in the zone of country.
2. Tottenham; in the zone of town.
3. Walthamstow; town.
4. Forrest House; town.
5. Stoke Newington; town.
6. Highgate; country.
7. Hampstead; country.
8. Kingsbury; country.
9. Wildsdon; town.
10. Kentish Town; town.
11. Clapton; town.
12. Hommerton; town.
13. Stratford; country.
14. West Ham; country.
15. West Ham Abbey; country.
16. East Ham; town.
17. Bethnal Green; country.
18. Hoxton; town.
19. Islington; country.
20. Somers' Town; country.
21. Regent's Park; country.
22. Paddington; town.
23. Paddington canal; town.
24. Six Elms; town.
25. Bayswater; town.
26. Hyde Park; country.
27. Green Park; country.
28. Southwark; town.
29. London Docks; town.
30. West India Docks; town.
31. Woolwich; town.
32. Isle of Dogs: town.
33. Greenwich Park; country.
34. Deptford; town.
35. Walworth; town.
36. Brompton; town.
37. Kensington; town.
38. Hammersmith; town.
39. Lambeth; country.
40. Kennington; country.
41. Camberwell; country.
42. Peckham, town.
43. Dulwich; town.
44. Clapham; town.
45. Fulham, country.
46. Putney; town.
47. Roehampton; country.
48. Wandsworth; town.
46. Wimbledon Park; country.
50. Tooting; town.
51. Norwood; town.
52. Sydenham; town.

one of the zones touched the sea. To render the plan complete, it would be necessary to have a circle of turf and gravel in the centre of the city, around St. Paul's, half a mile in diameter. In this circle ought to be situated all the government offices, and central depots connected with the administration of the affairs of the metropolis. That being accomplished, whatever might eventually become the extent of London, or of any large town laid out on the same plan and in the same proportions, there could never be an inhabitant who would be farther than half a mile from an open airy situation, in which he was free to walk or ride, and in which he could find every mode of amusement, recreation, entertainment, and instruction.

"Supposing such a plan considered desirable, it could not, perhaps, be carried into execution in less time than 50 or 100 years, on accouut of the large sums that would be required for purchasing the valuable houses that must be pulled down to form the central circle of turf, and the first zone of country. But, were government to determine the boundaries of certain future zones, and to enact a law that no buildings now standing on the future zones of country should be repaired after a certain year; and that, when such houses were no longer habitable, the owners should be indemnified for them by the transfer of other houses of equal yearly value in another part of the metropolis, belonging to government; the transition (considering the alteration in the value of property which is likely soon to take place, in consequence of the numerous rail-roads, &c., now going forward,) would not be felt as the slightest injustice or inconvenience. Government would be justified in adopting a plan of this sort, from its obvious reference to the public welfare; and a committee appointed to carry the law into execution should begin by purchasing such lands as were to be sold in the outskirts of the metropolis, in order to be able, at a future period, to exchange them for lands destined to form the central circle of the first zone. In endeavouring to give an idea of the situation of the zones round London, (*fig.* 143.) we have drawn the boundary lines as perfect circles; but, in the execution of the project, this is by no means necessary, nor even desirable. The surface of the ground, the direction of streets already existing, which it would not be worth while to alter, the accidental situations of public buildings, squares, and private gardens, with other circumstances, would indicate an irregular line, which line would at the same time be much more beautiful as well as economical."

In judging of the remarks in this and the preceding page, it must be recollected that they were written in 1829.

Mechanics' Register.

Rail Road Iron. The iron that will be required for rails, chairs, and carriages, and other works for the roads for which bills were obtained during the last session of Parliament, will amount to at least 220,000 tons, and for bills previously obtained, 70,000 tons, making a total of 290,000 tons, which will probably be in requisition for the next four years. With respect to the United States rail roads, we find by the *American Rail Road Journal*, that the extent either actually under contract, or in progress of being surveyed, amounts to more than 3000 miles. To lay a double line this distance will take 750,000 tons of iron. Lon. Min. Jour.

British Hardware. It appears from Parliamentary returns, that the

quantities of foreign iron imported into the United Kingdom in 1835, amounted to upwards of 21,150 tons, while the amount of British bar iron exported was 94,383 tons, and of other kinds of iron an amount which made the grand total 194,590 tons. A document from the custom house, entitled a "Return of British hardware and cutlery exported from the United Kingdom in the year 1835," makes the total amount 20,197 tons, the value of which was £1,833,042. Of this amount 11,062 tons, value £978,491 was sent to the United States. The whole amount for 1835 was an increase of 23 per cent. on that of the preceding year. Since 1820 the exports of hardware and cutlery have doubled in value. The exports of every description of hardware, with iron and steel, wrought and unwrought, amounted in value to £3,789,206, in 1830; and last year to £6,154,625.

Ibid.

Light Lace Veils. Mr. Babbage gives the following account of the lace made by the *phalæna pandilla*, a caterpillar. The invention is by a gentleman of Munich. He makes a paste of the leaves of the plant which is the usual food of the species of caterpillar he employs, and spreads it thinly over a stone or other flat substance; then, with a camel-hair pencil dipped in olive oil, he draws upon the coating of paste the pattern he wishes the insects to leave open. The stone being placed in an inclined position, a species of caterpillar which spins a strong web is laid at the bottom, and the insects commencing from that point, cut and spin their way up to the top, carefully avoiding any part touched by the oil, but devouring all the rest of the plant. These veils have not a great deal of strength, but they are surprisingly light. One of them, measuring twenty-six inches and a half by seventeen inches, weighed only 1.51 grain; a degree of lightness which will appear more strongly by contrast with other fabrics. One square yard of the substance of which these veils are made weighs 4¾ grains, whilst one square yard of silk gauze weighs 137 grains, and one square yard of the finest patent net weighs 622½ grains. Ibid.

Embossing on Wood. The following method of embossing on wood, invented by Mr. Straker, is extracted from the *Transactions of the Society of Arts*; it may be used either by itself or in aid of carving, and depends on the fact, that, if a depression be made by a blunt instrument on the surface of wood, such depressed part will again rise to its original level by subsequent immersion in water. The wood to be ornamented having first been worked out to its proper shape, is in a state to receive the drawing of the pattern; this being put in, a blunt steel tool, or burnisher, or die, is to be applied successively to all those parts of the pattern intended to be in relief, and at the same time is to be driven very cautiously without breaking the grains of the wood, till the depth of the depression is equal to the subsequent prominence of the figures. The ground is then to be reduced by planing or filing to the level of the depressed part, after which the piece of wood being placed in water, either hot or cold, the parts previously depressed will rise to their former height, and will thus form an embossed pattern, which may be finished by the usual operation of carving. Ibid.

Liverpool and Manchester Rail-way. The company opened their new tunnel, at the entrance of the rail-way at Liverpool, to the public, on Monday last. The tunnel is a mile and one-third in length, it is twenty-one feet high, and the span of the arch is twenty-five feet. The tunnel from one end to the other is cut out of the solid rock, which, in some places, rises as high as the spring of the arch. The crown of the arch is composed of very

strong brick work. The cost of this laborious undertaking amounted to 150,000*l.* It will be attended with great convenience to the public, as the former station was about two miles from Liverpool. It occupies about six minutes for a full train to pass through the tunnel. Ibid.

An International Rail-way Company has been provisionally formed for connecting London with Brussels and Paris by rail roads, via. Dover and Calais, with various branches. This measure appears to receive the sanction of all the governments concerned. The capital is estimated at £4,500,000, to be raised in England, France and Belgium. The greater part of the surveys have been already made. Abstract —Ibid.

Floating Wood. The prodigious quantity of wood brought by the sea to Iceland is thought by M. Eugene Robert to come from two continents at least. Trees are thrown ashore there, sometimes without roots, and without bark, the latter being frequently found by the side, folded like a roll of parchment. M. Robert has not been able to procure any floating fruits, but he has ascertained that mahogany is often landed in Iceland in the above manner. Ibid.

Tea-pots made by steam. Britannia metal tea-pots are now made by steam; the round bodies are spun, and the wooden handles and knobs are cut up by powerful steam engines. A good workman can spin twenty dozen of pot-bodies in a day. Ibid.

List of American Patents which issued in July, August, September and October, 1836.

The subjoined list of patents commences with those issued under the new patent law; we have heretofore numbered them from the first of January, to the end of the year, and shall hereafter pursue the same course, but on the present occasion we commence a new series with the new system.

Applications for patents now undergo a strict examination in the office, before they are granted; and upwards of three-fourths of those examined have, under the provision of the existing law, been deemed imperfect, and returned for amendment, or rejected for want of novelty. This, together with the delay incident in establishing a system of procedure altogether novel, accounts for the smallness of the number granted since its adoption.

	July.
1. *Locomotive engines.*—John Ruggles, Thomastown, Maine.	13
2. *Wool, &c. manufacturing.*—John Goulding, Boston, Mass.	29
	August.
3. *Turning sheaves, &c.*—Thomas Blanchard, city of New York.	1
4. *Rounding the edges, &c. of a block.*—Thomas Blanchard, city of New York.	10
5. *Boring and mortising the shells for do.*—Thomas Blanchard, city of N. York.	10
6. *Plank blocks, forming.*—Thomas Blanchard, city of New York.	10
7. *Boring holes and scoring dead-eyes.*—Thomas Blanchard, city of New York.	10
8. *Cutting scores round blocks, &c.*—Thomas Blanchard, city of New York.	10
9. *Riveting plank blocks.*—Thomas Blanchard, city of New York.	10
10. *Dye woods, cutting.*—Beriah Swift, Washington, N. Y.	10
11. *Double speeder for roving.*—Aza Arnold, N. Providence, R. I.	10
12. *Veneers, laying,*—John Soule, New Bedford, Mass.	31
13. *Polishing wire for reeds.*—Arnold Watkinson, Providence, R. I.	31

August.

14. *Cotton planter.*—Henry Blair, Glenn Ross, Maryland. 31
15. *Caoutchouc, applying.*—Edwin M. Chaffee, Roxbury, Mass. 31
16. *Cutting sheaves, &c.*—Thomas Blanchard, city of New York. 31
17. *Countersinking for bushes.*—Thomas Blanchard, city of New York. 31
18. *Forming cheeks of plank.*—Thomas Blanchard, city of New York. 31
19. *Springs for saddles.*—William Duchman, Morgantown, Penn. 31

September.

20. *Granite dressing machine.*—William Morse, Corrina, Maine. 8
21. *Expansion and contraction of metals, applying.*—Hazard Knowles, Hartford, Conn. 8
22. *Furnace for buildings.*—Frederick A. Friekardt, Easton, Penn. 8
23. *Mortising machine.*—David Clark, Brooklyn, Conn. 14
24. *Sawing shingles.*—Jonathan Hobbs, jr. Falmouth, Maine. 14
25. *Silver spoons, making.*—Josephus Brockway, Troy, N. Y. 20
26. *Paints, composition of.*—Harman Hibbard, Darien, N. Y. 20
27. *Cylinders.*—Henry P. Howe, Shirley, Mass. 20
28. *Lamp for spirits.*—Isaiah Jennings, city of New York. 22
29. *Power loom, take up motion.*—Horace Hendricks, Killingly, Conn. 22
30. *Light, production of.*—Isaiah Jennings, city of New York. 22
31. *Ever pointed pencil case.*—Jacob J. Lownds, Philadelphia. 22
32. *Stove.*—John Harriman, Haverill, Mass. 29
33. *Steam boiler.*—Jos. W. & Elias Strange, Taunton, Mass. 29
34. *Saw mill crank.*—Benj. F. Snyder, Elmira, N. Y. 29
35. *Breaks for wagons, &c.*—Henry West, Quincy, Mass. 29

October.

37. *Boot crimper.*—Ebenezer G. Pomeroy, Newark, Ohio, 1
38. *Purifying water.*—Moody Park, Madison, Indiana. 4
39. *Double hydrostatic oil press.*—Orestes Badger & Orrin Lull, Waterloo, N. York. 5
40. *Hand printing press.*—Frederick J. Austin, city of New York. 8
41. *Lamps.*—Alonzo Platt, Middletown, Conn. 8
42. *Lathe for turning.*—Enos & Nelson Alvord, Westfield, Mass. 11
43. *Rectilinial changed to circular motion.*—Benj. Babbitt, Bangor, Maine, 11
44. *Shelling corn.*—Joseph C. Baldwin, Staunton, Virginia. 11
45. *Window fastenings.*—N. Hall & Jotham Chase, Maine, 11
46. *Weaving stock bodies.*—Conrad Kile, Philadelphia, 11
47. *Turn-out for rail roads.*—John Talbot, Portsmouth, Virginia, 11
48. *Drying and burning saw dust.*—William Avery, Syracuse, N. Y. 11
49. *Stoves and fire places.*—Jordan L. Mott, city of New York. 11
50. *Endless chain carriage for saw mills.*—James Murray, city of Baltimore, 11
51. *Pad for coach harness.*—Andrew Deitz, Albany, N. Y. 14
52. *Combined plough.*—Samuel Cline, Berks county, Penn. 15
53. *Managing and applying fire in locomotives.*—Matthias W. Baldwin, Philad. 15
54. *Horse power.*—Orestes Badger, Cooperstown, N. Y. 15
55. *Door plates.*—Ithiel S. Richardson, Boston, Mass. 15
56. *Combing hemp, flax, &c.*—Samuel Couillard, Boston, Mass. 19
57. *Horse power.*—Daniel Fitzgerald, New York. 19
58. *Razor case and sharpener.*—E. M. Pomeroy, Wallingford, Conn. 19
59. *Putting up rope yarns.*—James H. Echols, Lynchburg, Virginia. 20
60. *Weavers' harness, making.*—John Blackman, Brooklyn, Conn. 20
61. *Cooking stove.*—John Whiting, city of Boston. 20
62. *Power loom take up motion.*—John P. Comsin, Killingly, Conn. 20
63. *Weavers' Harness.*—John Blackman, Brooklyn, Conn. 20
64. *Knob for doors.*—E. Robinson, F. Draper and J. H. Lord, Mass. 20
65. *Forming cloth without spinning.*—J, Arnold and G. G. Bishop, Norwalk, Conn. 20
66. *Ventilating and warming houses.*—R. Mayo and R. Mills, city of Washington. 24
67. *Friction matches.*—Alonzo D. Phillips, Springfield, Mass. 24
68. *Picking and breaking wool and cotton.*—John Schley, Augusta, Georgia. 27
69. *Preserving and exhibiting maps.*—N. K. Lumbard. jr. city of Boston. 27
70. *Parlour and cooking stove.*—Nicholas Smith, New Hampton, N. H. 27
71. *Scythes.*—Silas Lamson, Cummington, Mass. 29

LUNAR OCCULTATIONS FOR JANUARY, 1837.

Calculated by S. C. Walker.

Day.	H'r.	Min.			N.	V.
19	15	16	Im.	47 Geminorum, 6,	147	207
19	15	36	Em.		181	240
20	12	57	Im.	ω^1 Cancri ,6,	110	151
20	14	4	Em.		210	265
20	13	37	Im.	ω^2 Cancri ,6,7,	57	108
20	14	57	Em.		263	321
23	8	34	Im.	42 Leonis ,6,	83°	32
23	9	41	Em.		263°	183
29	16	6	Im.	2 Libræ ,5,6,	43	15
29	17	18	Em.		250	237

Meteorological Observations for September, 1836.

Moon.	Days.	Therm. Sun rise.	Therm. 2 P.M.	Barometer. Sun rise.	Barometer. 2 P.M.	Wind. Direction.	Wind. Force.	Water fallen in rain.	State of the weather, and Remarks.
				Inches	Inches			Inches.	
	1	69°	68°	29.80	29.65	SW.	Moderate.		Clear—cloudy.
	2	54	68	29.90	30.10	NE.W.	do.		Clear do.
☽	3	60	74	29.90	30.00	SW.	Brisk.		Cloudy—flying clouds.
	4	63	78	29.94	29.90	SW.	do.		Lightly cloudy—do.
	5	68	64	29 90	29.90	SW.	Moderate.	.24	Cloudy—thunder—rain.
	6	50	62	30 10	30.05	NE.	Brisk.		Clear do.
	7	52	64	30.10	30.15	E	do.		Clear ko.
	8	54	69	30.05	30.05	NE.E.	Moderate.		Cloudy—flying clouds.
	9	60	77	30 00	30.00	S.W.	do.	.4	Drizzle—clear.
⊗	10	62	63	30.00	30.05	NE.E.	Brisk.		Cloudy—cloudy.
	11	61	70	30.00	30.00	NW.W.	Calm.		Cloudy, do.
	12	62	76	30.00	30.00	W.	do.		Fog—flying clouds.
	13	65	82	30 08	30.10	W.	Moderate.		Fog—clear,
	14	70	80	30.15	30.15	S.	do.		Foggy—flying clouds.
	15	71	77	30.15	30.15	NE.	do.		Fog—lightly cloudy.
	16	68	73	30.15	30.15	E.	do.		Cloudy do.
☾	17	66	78	30.04	30.00	SE.W.	do.		Cloudy—lightly cloudy.
	18	68	83	29 90	29.90	SW.	do.		Fog—Clear
	19	70	83	29.90	29.90	SW.	do.		Fog do
	20	72	86	29.90	29.90	W.	do.		Clear do
	21	66	71	30.05	30.06	NE.E.	do.	.2	Rain do
	22	65	70	30 06	30.00	E SE.	do.	.5	Cloudy—rain.
	23	70	84	29.90	29.85	W.	do.		Heavy Fog—Clear
☺	24	68	78	29 90	29.90	SE.	do.		Fog—flying clouds.
	25	60	64	29.80	29.90	NW.	Brisk.		Clear, do.
	26	46	62	30.10	30 00	W.	do.		Clear, do
	27	52	62	29 70	29.55	SW.	do.	.30	Rain—flying clouds.
	28	56	61	29.50	29.50	SW.	do.	.60	Clear—lightly cloudy—rain in nt,
	29	47	49	29.65	29.75	NE.NW.	do.		Cloudy do
	30	36	60	30 04	30.04	NE.W.	do.		Clear do.
	Mean	60.73	71.53	29.95	29.95			1.25	

	Thermometer.	Barometer.
Maximum height during the month	86. on 20th.	30.15 on 7th, 14th, 15th, 16th.
Minimum do. .	36. on 30th.	29.50 on 28th.
Mean . do. .	66.14.	29.95.

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AMERICAN PATENTS, LIST OF, WITH EDITOR'S REMARKS, &c.

* Not issued but entered, by mistake.